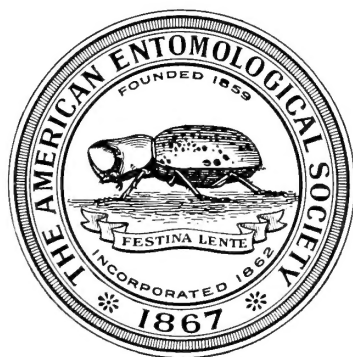


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NUMBER 18

THE GENUS BUCCULATRIX
IN
AMERICA NORTH OF MEXICO
(MICROLEPIDOPTERA)

BY
ANNETTE F. BRAUN



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HAROLD J. GRANT, JR.
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(Cincinnati, Ohio)

INTRODUCTION

Bucculatrix is one of the most easily recognized genera of Microlepidoptera. The elongate pointed face, tufted head, basal eye-cap of the antenna, and, in the male, the notched first segment of the flagellum assure recognition by casual examination.

In the early stages, species of this genus may be recognized by the short, very narrow, almost thread-like mines, and in the later stages by the feeding-pattern on the leaf made by the exposed larvae.

About 200 species are now known, occurring in all continents except New Zealand, with about three-fourths of the species in the northern hemisphere. About one-half are within the area of this monograph. In number of species, the genus is best represented in warmer regions, particularly in arid regions, where any collection is likely to contain representatives of it, some of them probably undescribed.

A total of 99 North American species are included in the genus. Of the 54 species listed in McDunnough's Check List of the Lepidoptera of Canada and the United States of America, Part II, Microlepidoptera (1939), eight (*capitallbella* Chambers, *albicapitella* Chambers, *rileyi* Frey & Boll, *crescentella* Braun, *chrysothamni* Braun, *tetrella*

Braun, *althaeae* Busck, *pertenuis* Braun) are reduced to synonymy. *Bucculatrix subnitens* Walsingham, previously known only from Mexico, is here recorded from Arizona. *Bucculatrix gossypiella* Morrill, of Mexico, is included because of the probability of its introduction in the Southwest. *Bucculatrix needhami* Braun was recently (1956) described. Fifty species are described as new. Examples of all of the species here treated have been examined, with the exception of *niveella* Chambers and *immaculatella* Chambers of which no types are in existence; these latter two species are assigned to their probable positions.

In connection with the evaluation of Chambers' types (*e.g.* the series of *luteella* and *packardella* at the Museum of Comparative Zoology) the following quotation is of interest. "But a few years ago I began to make a collection to be preserved as types of all my species. . . . Unfortunately, during my absence in Colorado, the greater part of this collection was destroyed. One or more specimens of the greater number of species were fortunately preserved, and most of the other species can be supplied. This collection is now in the Cambridge Museum. It contains types—pinned and spread—of something over 200 species." (Chambers, *Canad. Ent.*, IX, 39, 1877.) There is thus no assurance that his "types" actually represent the species described. Such uncertainty is apparent in the presumed types of *B. packardella* and *B. luteella* in the Museum of Comparative Zoology.

In the preparation of the slides of genitalia certain precautions must be observed to insure the retention of the tufts and patches of specialized scales on the intersegmental membrane between the seventh and eighth segments and on the eighth abdominal segment in the female. Such tufts of scales often constitute the only reliable characters for species separation. They are loosely attached and tend to float off *en masse* in spite of the utmost care; it is therefore advisable to make measurements and sketches during the progress of the work. In the female, the minute size and the transparency of the abdominal wall permit examination of the bursa copulatrix and signum *in situ*, and it is not necessary and usually not desirable to separate the anal segments from the rest of the abdomen. However, if this is desired, the separation should be made between the sixth and seventh segments, retaining segment 7 connected to the genital segments. In the species of Section IV, the position of segment 7 overlying the basal half of segment 8

has been retained in slides and drawings to show the natural position of the specialized scale structures attached to the intersegmental membrane and lying ventral to the ostium. The degree of telescoping of segment 8 into segment 7 may vary on the slides, and thus the apparent positions of the fringing scales of segment 7 and the specialized scale patches on the intersegmental membrane may vary in relation to one another and to the specialized scale tufts on segment 8. In the males of Section IV, no attempt was made to spread the harpes; in spreading, the thread-like vinculum may be broken; the twisting of the harpes to a ventral position is shown to best advantage unspread. Because of the weak articulation of the harpes on the vinculum in other sections, they may be lost easily. Unless otherwise noted, all slides were made by the writer.

With the exception of the setal map of the larva of *Bucculatrix canadensisella* Chambers, all figures were drawn by the writer.

All genitalia drawings were made by transmitted light, using a binocular microscope (fitted with a micrometer disc) for the gross structure, with details added by examination under a compound microscope. The degree of magnification of the figures of genitalia was determined by the amount of detail. The figures of less specialized female genitalia are one-half the scale of males. Small inset figures of specialized characters to a higher magnification may accompany the larger figures; such details are often visible only under the comparatively high magnification of a compound microscope. In so far as possible, ventral structures are shown by full lines, dorsal by broken lines. In particular this refers to female genitalia where characters of value are present on the dorsal surface of segment 8. It will be noted that the bursa copulatrix is omitted in most of the figures; it is impossible to show details of the complete signum without a higher magnification and larger figures than is desirable.

A total of over 2500 specimens has been examined in the study of the genus. Included are some 750 specimens in my own collection, many of them reared, and including types, allotypes or paratypes of 19 new species; over 900 specimens in the United States National Museum, including types, allotypes or paratypes of 30 new species; over 250 specimens in the Canadian National Collection, including types, allotypes or paratypes of 9 new species; some 150 in the collections

in the Academy of Natural Sciences of Philadelphia, including the Clemens' types and the Darlington Collection; the collections of Cornell University, some 250 specimens, including a recent collection of a large amount of material from the Southern Appalachians, an area scarcely represented in other collections, and several species from Arizona; the Cornell collections have contributed types and type material of 7 new species; the collection of A. E. Brower of Augusta, Maine, with representatives of three new species; Charles P. Kimball of Barnstable, Massachusetts and Sarasota, Florida submitted material from New York and Massachusetts, and a less extensive collection from Florida, including type material of three new species; from J. R. Eyer, State College, New Mexico, from the Los Angeles County Museum, from C. L. Remington, Yale University, and from J. McDunnough, Halifax, Nova Scotia, I have received material for study. To all of these, grateful acknowledgement is made. To Dr. J. F. Gates Clarke of the United States National Museum, for slides of types, for notes from literature not available to me, and for the many courtesies extended throughout the progress of the work, I express my sincere thanks.

Under Literature Cited (p. 189) is a short list of books and papers referred to in the text; of these, Friend's paper on *Bucculatrix canadensisella* Chambers (1927) is a valuable detailed study of a typical species of the genus.

Abbreviations when used in the text in referring to the location of material are as follows: A.F.B.Coll. (A. F. Braun Collection); A.N.S.P. (Academy of Natural Sciences of Philadelphia); B.M. (British Museum); C.N.Coll. (Canadian National Collection); M.C.Z. (Museum of Comparative Zoology); U.S.N.M. (United States National Museum). Location of material from other collections is listed without abbreviation or with obvious abbreviations.

Genus **Bucculatrix** Zeller

Bucculatrix Zeller, 1839. Isis, XXXII, 214. Generotype, *albedinella* Zeller (= *boyerella* Duponchel).

Ceroclastis Zeller, 1848. Linn. Ent., III, 295, t. 2, fig. 47. Generotype, *nigricomella* Zeller.

Face smooth, obliquely produced into a point extending well below the eyes (fig. 1), head tufted with long hair-scales, a forward-directed section of the tuft

attached to the vertex, the upward- and backward-directed section attached to the posterior part of the epicranium; tongue short, naked, maxillary palpi rudimentary, labial palpi minute, one-segmented, sometimes visible as a slender filament (fig. 1); antennae shorter than the wing length, basal segment of antenna (scape) enlarged forming an eye-cap clothed with projecting scales, and anteriorly fringed with long bristly setae; first segment of flagellum long, and in male typically with a deep notch (slight in some species); eye subglobose, large in some desert-inhabiting species.

Fore wings (Plates III and IV) lanceolate, more or less acuminate, costa and subcosta fused into a strongly sclerotized marginal vein, retinaculum a curved membranous hook in both sexes; radius obsolescent near base, R_1 from before middle of cell, R_2 , R_3 and R_4 from near end of cell, R_4 closely approximate to or connate or stalked with the stalk of $R_5 + M_1$, or rarely absent; media two-branched, M_1 stalked with R_5 , rarely separate; cubitus unbranched, running through the middle or near to middle of wing, the cell thus chiefly in the upper half of the wing, cubitus sometimes obsolescent or absent beyond cell (figs. 20, 23); 1st anal, the fold; A_2 not forked, strong, reaching margin beyond middle of dorsum; A_3 short, closely approximating the wing margin.

Hind wings lanceolate, from less than half the breadth of the fore wing to nearly as wide; frenulum of male a single strong seta, frenulum of female, two closely associated, or sometimes partially fused setae; $Sc + R_1$ to near middle of costa, R_s to costa near apex, media two-branched, cell open, cubitus unbranched; two anal veins often distinct.

Posterior tibiae with long hairs above and below, the upper decumbent, the latter pendant; middle pair of spurs articulating near base of segment, the inner twice or three times the length of the outer, apical pair shorter, inner twice the length of the outer.

Abdomen of the male in most of the species with an eversible scale sac, which is a mid-dorsal invagination of the body wall in the suture between the second and third segments (fig. 177, *et al.*), the distal circular area clothed with scales; the walls of the sac form the stalk when the sac is protruded and the scales expanded (fig. 82a); when expanded it resembles a flower-head of a Composite, the scales of different proportions and lengths in the several species. It may serve as an alluring organ.

Male genitalia. Although specialization within the sections and groups has resulted in apparent great diversity of structure, certain characters (or their modifications) are, with few exceptions, common to all the species of the genus: harpe weakly articulating with vinculum or closely associated with anellus and partially fused with it, of various shapes, commonly more or less inflated, with rounded apex (representing cucullus) usually defined by setal armature, or, harpe sometimes deeply bilobed (a specialization), the lobes distinguished by differences of setal armature, basal angles of costa produced as free arms, sacculus not defined; transtilla present in *ambrosiaefoliella*, then articulating with the

basal costal arms of harpe, and perhaps in *ainsliella* represented by a narrow sinuate band; anellus a broad or slender cone, often with lateral supporting sclerotizations; aedeagus more or less cylindric, often sinuate, or with apex produced beyond the aperture, aperture often elongate and armed with opposing teeth, proximal end rarely dilated and semi-globose, entrance of penis dorsal at the proximal end, cornuti rarely present; vinculum a mere thread (Plates XXIII to XXXIX) or a broader band rarely anteriorly greatly produced, often with a narrow thin median perpendicular plate; a definitive gnathos rarely present in completeness, lateral arms seldom present, gnathos most often undifferentiated, or represented merely by a minutely spinulose strip ventral to the anal tube for which the term subscaphium (sensu Diakonoff, 1954) is here adopted; socii usually two erect setose lobes, rarely reduced and nearly obsolete; uncus absent, except in a few species. Segment 8 modified in one section of the genus (Plates XLIV and XLV).

Female genitalia. The most distinctive characteristics of the female genitalia are the signum, consisting of a series of spined ribs, usually forming a ring nearly or quite encircling the bursa copulatrix near its posterior end, and the single pair of apophyses, those of the ninth segment (a second pair, those of the eighth segment, initiated in some specialized species); position of ostium various, opening either near center of sclerotized basal half of segment 8, or (in Section VIII) at the posterior margin of the sclerotized basal half of segment 8, or at the anterior margin of segment 8, or in the intersegmental membrane between segments 7 and 8; specializations may include the fringing of the posterior margins of the sclerotized section of segment 7 with specialized scales, the development of tufts or rows or patches of specialized (non-striated) scales on the intersegmental membrane and on segment 8, sclerotized outgrowths on segment 8, and finally extreme modification of the inner margins of the ovipositor lobes for rasping or piercing—the rasping rods—and the transfer of the function of the lobes to the terminal portion of the vagina, with its specialized vaginal setae (Braun, 1958); ductus bursae usually sclerotized for a greater or less length near ostium; inception of ductus seminalis adjacent to ostium, or more generally at the junction of the sclerotized section with the more anterior membranous section; in *B. platyphylla* only, a posterior lobe of the bursa copulatrix receives the ductus seminalis. Signum near posterior end of bursa and usually constricting it.

The preceding brief and of necessity inadequate description of the genitalia scarcely suggests the great diversity of structure within the genus. Genitalic structure is often correlated with food-plant groups and is the basis for division of the genus into sections.

Among the known food plants of *Bucculatrix* are representatives of some twenty-five plant families. In our area, members of the Compositae are probably hosts to nearly two-thirds of the species; trees or

shrubs of the amentiferous families to a fifth or more of the species. The larvae of a few species feed upon members of each of several plant families.

The species may be grouped into two main divisions on the basis of larval habits. (1) The typical division, which includes the majority of the species (Sections II to VIII). In this division, the larvae are leaf-miners in the first two instars and part of the third, and in the fourth and fifth instars (with few exceptions) feed exposed, usually on the under surface of the leaf, skeletonizing it or sometimes completely consuming the leaf substance, leaving irregular holes. A few species in this division are miners throughout larval life, never feeding externally. (2) A division apparently confined to this continent, in which the larvae, so far as known, are gall-formers, feeding within the gall throughout larval life, or, if miners in the earlier instars, stem borers in the later instars (Section I).

In those species comprising the typical division of the genus, the egg may be deposited on either the upper or the lower surface of a leaf. Eggs are usually flattened ovoid, and cemented to the leaf surface by an adhesive material which encircles them in a narrow band (figs. 35, 36, 37). An apparent exception to this general shape is the egg of *Bucculatrix thurberiella* Busck, which is described as "elongate, projectile shaped with about 10 projecting ridges and stands perpendicular to the leaf" (Morrill, 1927). The surface of the egg is variously sculptured; the hexagonal pattern of sculpturing is most common, and is that found in species of the amentiferous plant feeders (fig. 37); the sculpturing may take the form of longitudinal ridges converging toward the micropylar end, or the egg may be irregularly ridged in a more or less concentric pattern, the ridges breaking into knobs toward the micropylar end (fig. 36). Upon hatching, the larva enters directly into the leaf tissue.

The mines are narrow, almost thread-like tracks with parenchyma entirely consumed, and vary in length in different species from two or three to five or six centimeters, or even more in thin-textured leaves. They may at first follow a vein, abruptly turning out onto the leaf blade (fig. 52a), or be contorted (fig. 54b), or long and irregularly winding (fig. 43). A darkening of the leaf adjacent to the earliest portion of the mine, observed in some species, suggests a resting period preceding

resumption of feeding. In those few species which are miners throughout larval life, the mines of the fourth and fifth instars broaden into characteristically shaped blotches (figs. 45, 56). In the linear mines, the frass is deposited as a central blackish line, with the grains of excrement tending to appear as separated particles; a small blotch at the beginning of the mine contiguous to the egg-shell is free of frass; here the frass is contained within the egg-shell.

The first and second instars and part of the third are passed in the mine. On leaving the mine, without further feeding, the larva spins the flat "moulting cocoon," usually a thin smooth sheet of silk within which it moults. After this moult, the larvae are external feeders. A second moulting cocoon similar to the first but slightly larger is spun at the end of the fourth instar. In general, the exposed larvae feed on the underside of the leaf, skeletonizing small patches of leaf, which may have a characteristic shape and appearance, recognizable from field experience. In the fifth instar, in some species, the entire leaf tissue may be consumed, the small holes margined by veinlets. When the leaf is jarred, the larva may drop down on a silken thread. In the last instars, the larvae of *B. divisa*, feeding on the leaves of *Balsamorhiza*, of *B. arnicella* on *Arnica cordifolia*, and of *B. saluatoria* on *Artemisia tridentata* enter the leaf through circular holes and mine out the leaf tissue, with only head and thorax inside the mine. Such mines resemble *Coleophora* mines, but can be recognized by the position of the circular entrance holes at one edge of the mine (fig. 48b), instead of near the center.

In the two instars of the leaf-mining stage, the larva is flattened, apodal, the head lying in a horizontal plane, but as it is a tissue feeder, there is no great modification of mouth parts. The first and second moults take place within the mine; during the third instar the larva leaves the mine. In this instar and in the two following, the structure is that of the usual tissue-feeding larva (fig. 32). The body is cylindrical, the head nearly vertical; three pairs of thoracic legs are present, the prothoracic smaller than the meso- and metathoracic legs and furnished with but a single claw. The prolegs are comparatively long and slender, present on abdominal segments 3, 4, 5, 6, and 10, the abdominal prolegs bearing two transverse rows of uniordinal crochets, the anal prolegs a single transverse row. The anal prolegs in dorsal aspect

(fig. 33) are slender and diverging, presenting a good field recognition character. The last instars of those species which are miners throughout larval life (*e.g. angustata*) agree in general with the corresponding instars of the typical exposed-feeding larva, except that the head lies in a more nearly horizontal plane. The setal pattern of the fifth instar (fig. 34) is constant throughout this division of the genus with but minor variations; it will be noted from the setal map that, in this division of the genus, the setae are comparatively long.

The other main division of the genus (Section I) includes such species as *Bucculatrix fusicola* Braun, *B. needhami* Braun, *B. viguierae* new species, which are gall-formers and feed throughout larval life within the gall, and such species as *B. solidaginiella* new species and *B. cuneigera* Meyrick, which are leaf-miners in the early instars, and stem-borers in the later instars. In the gall-former, *B. needhami*, Dr. Needham's studies (1948) show that a non-feeding instar is interpolated between the last feeding instar and the pupal stage. This condition is probably present in all of the gall-formers, although to date no careful studies have been made of other species. In all observed instances, the full-fed larva passes the winter in the gall, emerging from the gall in the spring by a minute circular aperture, and spinning a typical *Bucculatricid* cocoon. Of the stem-borers, the mine of *B. cuneigera* only has been observed; in this instance the larva spins, in the end of the mine, a dense flat circular chamber, similar to the moulting cocoon of the species of the typical division of the genus, in which it passes the winter, emerging in the spring to crawl to the tip of a growing shoot and bore into it.

Bucculatrix needhami Braun may be taken as an example of larval structure in the gall-forming members of the genus. The larva in the last feeding instar, and still within the gall when full-fed, differs from the fifth instar larva of the leaf-mining and exposed-feeding species in several notable characters (fig. 31). The body is moniliform, with deep constrictions between the segments; the head is small, spinnerets non-functional; all three pairs of thoracic legs bear but a single claw; prolegs absent, their position merely indicated by a flattish area; setae are minute, almost microscopic. The larva is not capable of locomotion; "it did not creep, but lay on its side with the front end thrown back in a J-shaped hook, the head at the tip of the hook. It spun no

silk, not even enough to hold back the pellets of frass" (Needham, Journ. N. Y. Ent. Soc., LVI, 43-50, 1948). In this condition the larva passes the winter in the gall. In the spring a moult takes place within the gall, and the larva which emerges is of the normal lepidopterous form with functional spinnerets and long setae; it agrees with the typical fifth instar exposed-feeding larva in structure, except that a single claw is present on all three pairs of thoracic legs. "Here was a non-feeding instar, interpolated between larval and pupal stages; a clear case of hypermetamorphosis" (Needham, *l.c.*). This non-feeding larva gnaws a hole through the wall of the gall, emerging and spinning a typical ridged Bucculatricid cocoon. For additional details refer to Dr. Needham's paper in the Journal of the New York Entomological Society.

In the stem-borers of this division of the genus, larvae of which are leaf-miners in the early instars, the change to normal lepidopterous form must occur with the moult taking place at the end of the mine, since the power of active locomotion is necessary to reach the growing tip of the food plant.

The ridged cocoon is characteristic of the genus *Bucculatrix*, and is one of the most beautiful and intricate structures to be observed in the Lepidoptera. The manner of its spinning is briefly described below; for a detailed description of the process, the paper by R. E. Snodgrass in the Report of the Smithsonian Institution, 1920 (1922) entitled "The ribbed-cocoon maker of the apple," pages 496 to 509, and Plates 2 and 3, should be consulted. The larva spins, on whatever substratum is to serve as the location of the cocoon, a thin oval mat of silk; in some species a "palisade" of upright silken poles, each consisting of several united silk strands, previously encloses the area (fig. 57). The cocoon is spun in two sections, the two sections joined on meeting; spinning begins at what is to be the posterior end. The ridges are formed by the projecting ends of a series of loops spun from side to side, the larva backing away as the work progresses. At about two-thirds or three-fourths of what is to be the final length of the cocoon, the larva reverses its position and commences to spin at the other end of the mat, gradually enclosing itself and bringing the two sections together. The ridges seldom meet exactly and the joint is usually discernible and often conspicuous. Within this ridged and somewhat open structure, a close-woven inner lining is spun. To complete the entire structure may

require an incredibly short time—a few hours, or more often, as much as a half day. The proportions of the cocoons of the several species may vary from rather broad and stout to elongate and slender; the number of ridges is constant (with some slight variation) for the species. Shape and number of ridges may thus be diagnostic characters of a species (Plates VII, VIII, IX). In color, cocoons vary from pure white to dark brown. The pale green color of the cocoon of *Bucculatrix flourensiae* new species is unique in the genus.

The ridges of the cocoon are ill-defined in some species or are occasionally wanting. Cocoons spun by parasitized larvae are often not characteristic of the species and may be abnormal in some respect, for example, smooth instead of ridged.

Pupae (figs. 38, 39, 40) with the appendages free from the body wall; abdominal segments 3–7 movable in the male, 3–6 in the female; the tenth abdominal segment with a projection on each side ending in a short strong spine, and a small dorsal tubercle at its anterior margin bearing a pair of minute spines; on dorsal surface of abdominal segments 2–7, a row of minute strong spines along the anterior margins; the hind wings usually concealed by the fore wings, but sometimes their tips visible; foreshadowing the genital openings of the imago is the single genital opening of the male on the ninth segment (fig. 39); and the two genital openings of the female on the eighth and ninth segments respectively (fig. 40).

On emergence, the pupa is thrust through the anterior end of the cocoon, exposing half or more of its length. The skin splits transversely between vertex and prothorax and longitudinally along the prothorax and mesothorax (fig. 42a).

The majority of the species have but one generation in a year; two, or even three generations occur in some of the oak-feeding species, and in some Composite feeders. The winter is passed in the pupal state in species of temperate latitudes or more or less humid regions; it is probable that the period of emergence in arid regions is dependent on the season of precipitation. Some few species may hibernate in the imaginal state.

The percentage of parasitism is unusually high; a third or more of the larvae of any rearing may prove to be parasitized; sometimes as high as 90 percent of the larvae may be parasitized.

Wing expanse of the imagoes varies from 4 mm. to 14 or 15 mm. in our largest species, members of the gall-forming section of the genus (Section I).

Except in Section I (the gall-formers and stem-borers), characterized by very oblique or longitudinal streaks on a white ground (Plate I, figs. 3, 4, 5, 6), the wing pattern of the imagoes conforms to a general type, which is however often obscured by expansion or contraction or obsolescence of marks. This pattern consists of an alternation of dark and white (or whitish) oblique bars or streaks from costa; the first of these dark areas from base to about one-third, followed by a pale bar, a second dark bar, a second pale bar separated from a whitish bar or streak near apex by the darker color or a dusted area; on the dorsal margin, a little distad of the first costal bar, a white or whitish area separated from a second whitish area or streak by a darker area which (in most species) includes a patch of black or black-tipped raised scales, sometimes conspicuous, which is one of the identifying characters of the genus. This series of marks may perhaps be most clearly recognized in some species of Section IV (Plate II, figs. 15, 16, 17, 18). Any one or more of these bands or streaks may be obscured or somewhat displaced by dark dusting, or be obsolescent; for example, in a white species, the darker bands are reduced or obsolescent, and the wing would then be described as white, with darker or dusted streaks (figs. 7, 8, 13, 14); in other species, the condition is reversed, and the extent of dark marks increased (figs. 11, 17, 18); all gradations may exist between these various modifications of the general wing pattern (figs. 9, 10, 12). A pale median basal streak is sometimes present. There is thus an apparent great diversity of wing markings.

In general, resemblance of wings can not be assumed to indicate relationship; variation within a species may be greater than differences between species, and unrelated species may superficially resemble one another. For example, *Bucculatrix sexnotata* Braun and *B. callistricha* new species are both dark brown with silvery marks; the former is a Composite feeder and belongs to Section II, the latter, on *Corylus*, to Section IV, the two unrelated, as evidenced by examination of genitalia. Genitalia must be examined for certain determination except in the most distinct species.

Bucculatrix is an isolated genus, without near relationship to any existing genus. It has generally been associated with the Lyonetiidae, but is sometimes regarded as constituting a separate family, Bucculatricidae. The median position of the strong cubital vein (lower margin of the cell) in the middle or above the middle of the wing, and the tendency for the veins to disappear by obsolescence rather than by coalescence are distinctive Lyonetiid characters, and thus ally *Bucculatrix* to the Lyonetiidae whether or not the genus is regarded as a separate family.

Characters supporting family rank for the genus are the more primitive pupa with appendages free in contrast with the obtect pupae of the reduced genera of the Lyonetiidae, the antennal structure of the male, the eversible scale sac of the male abdomen, the characteristic signum and the single pair of apophyses of the female, the larval structure and habits and the unique cocoon.

The diversity of genitalic structure and the accompanying specialization, with similar specializations in widely separated geographic areas, indicates an ancient genus with a long period of development and differentiation. This points to wide distribution in ancient times with specializations characterizing the several sections of the genus developed before the period of isolation.

There is no evidence to substantiate any of the proposed theories of the phylogenetic origin of *Bucculatrix*. Various conjectures have been made. Meyrick (Proc. Linn. Soc. New South Wales, VII (Series 2nd), 1892, p. 601) makes the following statements: "Probably a development of the *Nematobola* group, but no immediate connection can be made out. . . . The peculiar larval habits may be compared with those of *Nematobola*" [now assigned to the Yponomeutidae]. The larval structure and habits as described for *Nematobola candescens* Meyrick (*l.c.*, p. 593) are very similar to those of *Bucculatrix*. The antennae of the male in *Comodica* Meyrick (Lyonetiidae) "with deep notch immediately above basal joint" (*l.c.*, p. 561) suggests a possible relationship to *Bucculatrix*. Markings of several of the species included in *Comodica* are similar to those of some species of *Bucculatrix*. Later, Meyrick (1927) derives the Lyonetiidae, including *Bucculatrix*, from the Tineidae as "a specialised development of the Tineidae."

Philonome Chambers, stated by Forbes (1923) to be "hardly distinct from *Bucculatrix*" is shown by genitalia, which are Lyonetiid, to be unrelated to *Bucculatrix*.

Examination of genitalia has disclosed an unusual number of sibling species.¹ These may be either allopatric or sympatric species. Such pairs of species may be characterized by essentially similar genitalia which however differ in the more minute morphological characters. Some such pairs, in addition to morphological differences, may be separated by differences of habitat requirements. Among the sibling species are *Bucculatrix variabilis* Braun and *B. separabilis* new species, which feed on the same food plant at the same time; these had been considered varieties of a single species; genitalia demonstrate their reproductive isolation. *Bucculatrix arnicella* Braun and *B. tridenticola* new species are almost indistinguishable in the imaginal state; by genitalia they are distinct; one is a forest species, the other, a species of the sagebrush desert. Some pairs of species (as *B. evanescens* new species and *B. benenotata* new species) are easily separated by wing marks, but the similar and often unique character of the genitalia indicate very close relationship.

In the present treatment of *Bucculatrix*, the species are grouped into eight sections:

I. Species 1-16	p. 37
II. Species 17-64	p. 59
III. Species 65	p. 126
IV. Species 66-90	p. 128
V. Species 91-93	p. 171
VI. Species 94	p. 175
VII. Species 95	p. 178
VIII. Species 96-99	p. 180

These sections are based primarily on genitalic structure, which is however often correlated with food plant groups.

¹ Sibling species are defined as "Pairs or groups of closely related species which are reproductively isolated but morphologically identical or nearly so" (Methods and Principles of Systematic Zoology, Mayr, Linsley and Usinger, 1953).

A section or subsection or group can not be assumed to be derived from another. Each must have originated independently from ancestral stock, although evolutionary trends may be followed in some sections or groups. Highly specialized characters of the genitalia have developed in each section, distinct from those of other sections, often resulting in great diversity of form within a section. Within each section there may be several ramifications, each culminating in species with specialized characters. Divergence of structure from the general type of the section or group is regarded as a specialization; the most complex (in genitalia structure) are considered to be the most specialized. Thus the degree of specialization determines the sequence of species.

*Key to the Species of Bucculatrix Based on Coloration and Markings*²

1. Ground color of fore wings white, creamy white or pale, i.e., the greater area of wing light, the markings formed by spots or streaks of darker or dark-tipped scales; the basic pale ground color sometimes obscured by dusting of dark-tipped scales, the wings thus sometimes appearing dark 2
- Ground color of fore wings not white; whitish ochreous, ochreous to dark brown or black, or sometimes irrorate. (Included here are species of which the general aspect of the ground color is ochreous, although the scales may shade from white at base through ochreous to brown or fuscous at tips) 60
2. Ground color clear white or creamy white, often lustrous, with little or no dusting except that the scales of the marks may be dark-tipped (if dusting present minute and scarcely evident) 3
- Basic ground color white, but often obscured by dusting of dark-tipped scales 48
3. Size usually large (8 to 15 mm. wing expanse); wings (of some species) almost wholly white or creamy white, markings if any, at least in part longitudinal; mostly gall-formers or stem-borers in larval state 4

² Because of the similarity of many species, sometimes unrelated, and variation within a species, this key, except in the case of species with distinct and well-defined markings, can serve only as a partial aid to determination. In variable species there are some individuals in which the general color may appear dark even though the basic ground color (i.e. bases of scales) is white. Although the aspect of two species may be different, the characters are often too intangible to be expressed in a key. Genitalic characters are the only certain means of identification.

- Expanse usually less than 8 mm., markings usually consisting of oblique costal and dorsal streaks or blotches; a longitudinal streak may be present along the fold; leaf miners and external feeders (as far as known) in larval state 20
4. Elongate ocherous streaks and patches, longitudinal streaks near costa and in fold; no ciliary line 5
- If marked with elongate ocherous streaks, then costal and dorsal marks are oblique streaks, rather than patches 6
5. Fore wings snowy white (17) *albaciliella*
Fore wings creamy white (18) *ochristrigella*
6. Fore wings lustrous creamy white (10) *ochritincta*
Ground color of fore wings pure white 7
7. Fore wing immaculate except for a few dark scales 8
Fore wing with longitudinal streaks or lines and/or oblique streaks, scales more or less dark-tipped 9
8. Two lines of dark-tipped scales in the terminal cilia (8) *niveella*
No dark lines in cilia; a few black scales in fold and at end of cell
(9) *parvinotata*
9. A conspicuous median dark streak from base curving to termen beyond middle and following termen to apex 10
Median streak from base if present not as above 11
10. Dark median streak from base to termen and apex the only longitudinal marking (15) *bicristata*
Above outer part of median streak, close to and parallel to it, a slender longitudinal streak (4) *magnella*
11. An oblique streak from before middle of costa 12
Oblique streak near base, if present, arising below costa 15
12. A streak of blackish scales in line with the longitudinal axis of the wing from termen near apex to tip of apical cilia (3) *montana*
Blackish scales on termen and in apical cilia, if present, not in line with longitudinal axis of wing 13
13. Wing marked with two longitudinal lines of black dots and groups of pale ocherous brown-tipped scales; expanse 8 mm. ... (12) *micropunctata*
Wing not thus marked 14
14. Third costal streak oblique, crossing wing to termen, white area beyond not attaining termen (2) *solidaginiella*
Third costal spot irregular, not reaching termen, white area beyond conspicuous and extending across wing to termen near tornus, its outer margin a narrow lustrous bar lying along the black-tipped scales of margin of termen (13) *inuitata*
15. No defined longitudinal streak, except a faint yellowish shade along fold; costal and dorsal spots irregular; apex of wing white
(14) *seneciensis*

- Longitudinal streak from base well-defined; longitudinal streaks also present on disc 16
16. An oblique longitudinal streak arising below costa at basal third; costal streak beyond middle crossing wing to tornus (1) *fuscicola*
Longitudinal streaks in disc lying along axis of wing 17
17. Basal streak broken in mid-length by a patch of black scales; a broad sometimes ill-defined stripe beyond parallel to termen 18
Basal streak along fold to two-fifths the wing length 19
18. A slender long discal streak parallel to basal streak; a line of fuscous scales between it and the basal streak; black-tipped scales along termen continued as a blackish apical hair pencil (5) *needhami*
Discal streak broad; no terminal row of dark-tipped scales; apex of wing white, no dark hair pencil (11) *viguierae*
19. Lines of dark-tipped scales along termen approximate and nearly parallel, wing lustrous, acute, expanse 12 to 12.5 mm. (6) *longula*
Lines of dark-tipped scales along termen distant and converging toward apex; wing less lustrous, less acute, expanse 9.5 to 10 mm. (7) *simulans*
20. The white ground color immaculate or nearly so, any dark scales confined to apex and cilia 21
Dark or dark-tipped scales grouped into more or less defined costal and dorsal or transverse markings (a faint longitudinal streak may be present in fold) 23
21. Immaculate, no dark dusting (31) *immaculatella*
With at least a few dark or dark-tipped scales 22
22. Nearly immaculate, or a few pale-tipped scales suggesting position of marks some (63) *enceliae*
A few brownish or black-tipped scales in apex and cilia of termen
some (25) *evanescens*
some (30) *staintonella*
23. Fore and hind wings pure white; conspicuously contrasting areas of black or blackish scales (62) *atrosignata*
Both pairs of wings not white, no large black contrasting areas; if some marks are black, then hind wings not white 24
24. Some black or black-tipped scales placed singly or grouped to form small or minute round or elongate dots; at least such a dot at end of cell. . 25
No such defined small black dots on wing; black-tipped scales if present clustered into more diffuse markings 32
25. Black scales and dots numerous (61) *nigripunctella*
Not more than three such groups or dots of black scales, but sometimes a few scattered black scales 26
26. A black discal dot either round or elongate the only such black mark . . 27
A black discal dot not the only black mark 30

27. Black spot or dot elongate, lying longitudinally 28
 Black spot a mere dot, but usually distinct (64) *latella*
28. Markings ill-defined, sometimes obsolescent; black discal dot sometimes
 absent (60) *sororcula*
 Markings well-defined, discal spot on outer margin of oblique mark from
 costa 29
29. Black spot at middle of oblique clay colored band from middle of costa
 (91) *anaticula*
 Black spot at apex of broad triangular streak from middle of costa
 (92) *disjuncta*
30. Longitudinal faint yellowish streaking only; scattered black scales
 (25) *evanescens*
 At least some oblique ocherous streaks 31
31. Black discal dot farther from spot in fold than from black scales at apex
 (53) *leptalea*
 Black dots equally spaced (57) *seorsa*
32. Fore wings lustrous white, ocherous oblique costal and dorsal streaks;
 three black marks in a series at apex (87) *copeuta*
 Fore wings not lustrous 33
33. Dark or dark-tipped scales grouped to form four costal patches, the first
 near base (cf. figs. 7, 13) 34
 Dark scales not thus characteristically grouped 36
34. Deeply black-tipped scales predominating in the marks 35
 Brown-tipped ocherous scales predominating in the marks
 (98) *sphaeralceae*
35. Scales deeply black-tipped, first three costal patches almost black
 (99) *thurberiella*
 More or less ocherous admixture in the markings (97) *gossypiella*
36. A mid-dorsal oval or half-crescent dark mark including a patch of raised
 scales 37
 Dark marks on mid-dorsum if present made up of a more or less irregular
 group of ocherous, dark- or black-tipped scales 38
37. Dorsal oval well-defined, margined by whitish scales; ground color shaded
 with pale ashy gray some (47) *divisa*
 Dorsal mark a half-crescent, not a well-defined oval (59) *columbiana*
38. With at least one longitudinal streak (faint in some species) 39
 Without any longitudinal streaks 47
39. With several slender longitudinal ocherous or dark dusted streaks
 some (30) *staintonella*
 Longitudinal streaks short, along costa and/or in fold 40
40. Lines of darker scales in fold and along costa 41
 Longitudinal streaks from base along costa only (sometimes a luteous
 streak above fold in No. 33) 43

41. Basal third of wing above fold immaculate, except for a line of black-tipped scales along costa, and contrasting with remainder of wing
(23) *separabilis*
Not as above; basal and apical areas not contrasting 42
42. Costal marks more or less quadrate (93) *ceanothiella*
Costal marks attenuate below costa (58) *angustisquamella*
43. Streak along costa diverging from costa before middle and forming an oblique streak 44
Costal streak not diverging to form an oblique streak 46
44. Second costal streak recurring upward toward apex and enclosing a similarly curved white streak (33) *kimballi*
Second costal streak and its outer margin straight or nearly so 45
45. Second costal streak prolonged to middle of termen, there meeting a few black scales; eastern some (32) *agnella*
Second costal streak not ending in black scales on termen; western
(21) *ericameriae*
46. Wings narrow, costal streak sometimes absent (27) *floccosa*
Wings broad, costal streak ending in a patch of brown-tipped scales; eyes large (63) *enceliac*
47. Markings chiefly bright ochreous (19) *eurotiella*
Markings formed by clusters of dark-tipped scales (20) *tenebricosa*
48. Fore wings so densely dusted with dark brown- or fuscous-tipped scales as to obscure the whitish ground color 49
A considerable area of the white ground color still evident in bases of scales or appreciable white areas 51
49. A well-defined dorsal oval (89) *ainsiella*
Dorsal oval if present blending with the general color of the area 50
50. An irrorated dark brown median area lying between the pairs of costal and dorsal white streaks some (22) *variabilis*
Pale ground color largely obscured by dark-tipped scales, the markings blackish, the only white area of the wing a wedge-shaped streak from base to one-third (51) *kochelella*
51. Basal half of wing paler than outer half 52
Basal half of wing not or not appreciably paler than outer half; a few species with wings of general white aspect included here 53
52. Dorsal oval present, elongate, markings black; a broad patch of black-tipped scales on costa curves in middle of wing and extends to termen above tornus (56) *spectabilis*
Dorsal oval of the usual form; markings not black, scales brown-tipped
some (94) *pomifoliella*
53. Size minute, expanse 4 to 4.4 mm., an oblique band from two-thirds of costa the best defined mark (95) *ilecella*
Size not minute 54

54. With four costal dark patches or streaks, the first near base 55
 Costal patches not thus characteristically placed 56
55. Costal patches becoming indistinct in middle of wing and blending with
 the ground color; western some (96) *quadrigemina*
 Costal patches crossing or nearly crossing wing; the third costal the dark-
 est and most conspicuous; eastern (90) *eclecta*
56. Wing scales of two sizes; wing below fold toward base clothed with very
 small pale gray scales, a few normal black scales may dot this area
 (26) *benenotata*
 Wing scales all of one kind 57
57. Beyond middle of costa, a broad patch of black-tipped scales narrows
 abruptly below costa, curves into disc almost to tornus, thence curves
 upward to apex (29) *franseriae*
 Not as above 58
58. Fore wings with slight ochereous tinge, dusted with brownish ochereous
 scales; groups of closely placed brown-tipped ochereous scales form the
 narrow oblique streaks (24) *brunnescens*
 General aspect of fore wing white, more or less dusted with dull ochereous
 scales 59
59. First and second costal streaks blending into the general dusted ground
 color below middle of wing, a black dot in middle of wing at end of
 second costal spot; a sinuate line of black-tipped scales through outer
 third of cilia (52) *salutatoria*
 First costal streak short, second prolonged to termen, there meeting a few
 black-tipped scales; a line of dark-tipped scales through middle of
 cilia some (32) *agnella*
60. Ground color of fore wing black, faintly tinged with dark brown; marks
 lustrous silvery or pale golden 61
 Ground color not black; brown or dark fuscous, or ochereous or whitish,
 with white or silvery or whitish markings; either with or without a
 dusting of dark-tipped scales 64
61. A transverse silvery or pale golden fascia at one-fourth ... (83) *fugitans*
 No fascia; costal and dorsal silvery spots 62
62. A silvery spot or streak at base of wing 63
 No silvery mark at base of wing (88) *locuples*
63. Tegulae and a short streak from base below fold silvery; three costal and
 two dorsal silvery spots, and silvery scales around apex
 (84) *callistricha*
 An oblique silvery spot from base of costa, silvery spots from near middle
 and two-thirds of costa, and two silvery dorsal spots; silvery scales at
 apex (46) *sexnotata*
64. With silvery marks 65
 Marks not silvery 71

65. Costal and dorsal spots or streaks silvery in male only, raised scales never preceded by a silvery spot; cocoon stout, typically dark gray
(71) *trifasciella*
Costal and dorsal spots or streaks silvery in both sexes 66
66. Ground color of fore wing ocherous, sometimes darkened by dark-tipped scales; three costal and two dorsal pale or silvery spots 67
Fore wings ocherous or brown, not speckled with dark-tipped scales; two silvery costal streaks and a transverse silvery streak or arc at apex .. 69
67. Scales golden brown, each scale tipped with dark brown, wing thus appearing speckled brown; hind wings darker than the fore wings
(82) *paroptila*
Fore wings if golden brown, not thus evenly speckled with dark brown, hind wings never conspicuously darker than fore wings 68
68. Silvery spots usually broad and brilliantly lustrous, raised scales preceded by a silvery spot; cocoon stout, brown, similar to that of *trifasciella*
(72) *quinquenotella*
Silvery spots or streaks narrower, sometimes tending to be obscured; pale spot preceding raised scales not silvery; cocoon slender, pale stramineous (73) *domicola*
69. Basal area of fore wing evenly ocherous to dark margin of first costal streak 70
Brown of basal area of fore wing divided by longitudinal ocherous streaks; a line of overlapping scales from apex to tip of apical cilia
(43) *polymniae*
70. Outer half of fore wing blackish and strongly contrasting with the paler, ocherous basal half (45) *subnitens*
Outer half of fore wing not strongly contrasting, but wing usually darkened between the costal streaks (42) *eupatoriella*
71. Ground color dark brown or fuscous, usually not or little dusted with darker-tipped scales, sometimes irrorate (but usually evenly colored) 72
Ground color of fore wing pale to darker ocherous, sometimes dusted, or if whitish ocherous, the ground color obscured by dusting; if brown or fuscous, then much dusted or irrorated; the markings whitish or paler than the ground color or often delimited by dark-tipped scales of the ground color 79
72. Fore wing irrorated fuscous, two white transverse fasciae .. (37) *taeniola*
No transverse fasciae, transverse bands if present, broken or angulate .. 73
73. A white longitudinal streak from base of wing 74
No such longitudinal streak 77
74. Longitudinal streak close to costa and gradually widening
(16) *cuneigera*
Longitudinal streak becoming median, not widening 75
75. Median streak extending to three-fifths the wing length .. (39) *angustata*
Median streak short, one-half or less the wing length 76

76. Median streak obsolescent beyond one-fourth the wing length
 (40) *adelpa*
 Median streak distinct nearly to one-half wing length and margined on
 each side by a line of black scales (41) *plucheae*
77. Two costal, two dorsal and an apical white spot; wing below fold to first
 dorsal spot grayish ocherous or tawny (44) *speciosa*
 Three oblique costal, two dorsal and an apical white spot 78
78. Base of wing white below fold to dorsum (85) *eugrapha*
 White at base of wing not attaining dorsum (77) *canadensisella*
79. No apical ciliary line of dark-tipped scales 80
 Apical ciliary line well defined 83
80. Wings broad, hind wings one and one-half times as broad as typical
 (69) *platyphylla*
 Hind wings narrow, typical 81
81. Fore wings bright reddish ocherous, markings ill-defined, raised scale patch
 large; expanse 8 mm. (70) *ochrisuffusa*
 Fore wings creamy white to pale ocherous, size very small, 5 to 6 mm. .. 82
82. No defined marks, minutely brown-tipped scales most numerous in outer
 costal area; no patch of raised scales (36) *pallidula*
 Wing color shading to pale orange in middle of wing, there forming inner
 margin of a pale streak; raised scales variable, sometimes absent
 (80) *luteella*
83. The white basal third and the outer somewhat dusted third contrasting
 sharply with the black median area of fore wing (49) *insolita*
 Basal third of fore wing not white and not sharply contrasting with the
 median area 84
84. Fore wing irrorated dark gray, with white or whitish streaks 85
 Fore wing not dark gray; if dark, then brown 86
85. Contiguous to black streak in fold, a short basal dash of elongate white
 scales (55) *tridenticola*
 No such white basal dash (54) *arnicella*
86. General aspect of the wing dark, brown or ocherous brown, not densely
 dusted; if dusted general aspect remaining rather uniform 87
 Scales of ground color whitish ocherous, darker tipped, pale ocherous or
 yellow to dark ocherous, with a greater or less degree of dark tipping;
 markings paler, white to ocherous or yellowish; or ground color pale,
 the markings formed by darker or dark-tipped scales 92
87. Wings suffused with brownish or reddish ocherous, longitudinal and oblique
 markings obliterated some (30) *staintonella*
 At least some pale markings present 88
88. Before middle of wing, a pair of curved white streaks meeting or nearly
 meeting; at apical third, a white costal streak meets the apices of a
 pair of white streaks from near tornus some (22) *variabilis*
 Not as above 89

100. Middle of wing occupied by a broad angulated transverse dark band, into which projects a pale costal streak, nearer its proximal than its distal border (79) *polytita*
 No such dark transverse band 101
101. Angulated pale fascia from basal fourth to dorsum produced along middle of wing and sometimes meeting the second pale bar; pale markings sometimes obscured by darker dusting some (74) *zophopasta*
 Pale costal and dorsal marks at one-fourth not produced along middle of wing and thus separated from the second pale bar by ochereous often dusted ground color (67) *albertiella*
102. Ground color brownish ochereous to brown, usually dark brown below fold, considerable dusting of black-tipped scales; dorsal oval apparent and margined with pale scales (48) *illecebrosa*
 General aspect creamy white to yellow or yellowish, the darker areas more or less dusted 103
103. Fore wings creamy white, whitish ochereous or ochereous, dusted with ochereous- or brown-tipped scales, the markings paler 104
 Fore wings yellow or yellowish; three very oblique parallel costal bars or streaks; each antennal segment shading from buff to dark brown, an occasional pale segment near tip of antenna (81) *recognita*
104. Four costal dark patches, the first near base, separating the creamy white marks near costa, but fading out below the middle of the wing and blending with the pale color some (96) *quadrigemina*
 Dusted areas separating pale marks extending to dorsum, the dusted area of basal fourth produced along fold; antennal segments extremely short and annulate with dark brown (68) *coniforma*
105. Whitish ground color obscured by the slight to dense dusting of dark-tipped scales 106
 Fine dusting not obscuring the pale ground color, except sometimes in darkest specimens; dark oblique costal, dorsal and longitudinal streaks .. 108
106. Prevailing ground color a speckled dark grayish brown; head and thorax white contrasting with the dark wings; cocoon pale green
 (28) *flourensiae*
 Prevailing color reddish ochereous or reddish brown 107
107. Dorsal oval conspicuous; costal streak beyond middle broad on costa; basal half of wing usually paler than outer half ... some (94) *pomifoliella*
 Dorsal oval not defined; markings produced by very oblique and longitudinal dark streaks (65) *sporobolella*
108. Oblique costal and dorsal streaks very oblique, a brownish fuscous streak in fold from base and above it and parallel, a long white or whitish ochereous streak; eastern coastal (34) *ivella*
 Costal and dorsal streaks less oblique, whitish basal streak short and nearer costa; widespread (35) *ambrosiaefoliella*

*Key to the Species of Bucculatrix Based on Male Genitalia*³

1. Harpe with definite ventral and dorsal lobes usually distinguished by setal differences, or indistinctly bilobed at apex 2
Harpe without ventral and dorsal lobes, not bilobed at apex, but sometimes with a small apical projection or lobe 15
2. Sternite of eighth abdominal segment with sclerotized plates (see figs. 235a, 237c, 239c) 3
Sternite of eighth abdominal segment not thus specialized 5
3. Sclerotized plate produced into a pair of free arms 4
Sclerotized plate with merely a low median lobe (98) *sphaeralceae*
4. Tergite of segment 8 a large flat plate terminating in two black pillars
(99) *thurberiella*
Tergite of segment 8 not specialized (96) *quadrigenina*
5. Harpe deeply divided into a long slender dorsal lobe and a broad ventral lobe as long as the dorsal lobe 6
If harpe deeply divided, then dorsal lobe much exceeding ventral lobe .. 7
6. Ventral lobe clothed with decumbent setae, dorsal lobe setose in outer half
(95) *ilecella*
Outer (ventral) lobe thin and sparsely setose, dorsal lobe with heavy apical setae (29) *franseriae*
7. Ventral lobe of harpe arising near middle or outer third of harpe 8
Harpe lobed near or at apex 10
8. Lobes of harpe separated by a broad sinus 9
Lobes of harpe not thus separated, differentiated by setal armature
(90) *eclecta*
9. Apex of dorsal lobe with heavy setae, ventral lobe with short fine setae
(46) *sexnotata*
Dorsal lobe with long setae laterally, ventral lobe with a few very long setae (97) *gossypiella*
10. Harpe distinctly lobed at apex, the lobes separated by a deep sinus ... 11
Harpe indistinctly lobed at apex, or with a small inner lobe near apex .. 12
11. Lobes armed with long strong setae; long free arms of gnathos present
(13) *inusitata*
Lobes armed with short strong setae, gnathos not differentiated
(40) *adelpa*
12. A small inner lobe near apex of harpe (87) *copeuta*
No inner lobe, harpe lobed at apex 13
13. Harpe indistinctly lobed, but parts fused and strongly sclerotized, apex dark-pigmented; vinculum expanded at base into lateral wings
(94) *pomifoliella*
Not as above 14

³ Omitted from the key: *niveella* Chambers, *ochritincta* n. sp., *ericameriae* n. sp., *benenotata* n. sp., *immaculatella* Chambers, *pallidula* n. sp., *carolinae* n. sp., *speciosa* n. sp., *subnitens* Walsingham, *spectabilis* n. sp., *nigripunctella* Braun, *coniforma* n. sp., *platyphylla* n. sp., *ochrisuffusa* n. sp., *litigiosella* Zeller, *ceanothiella* Braun.

14. Harpe slender, abruptly widening at apex, where bilobed, each lobe armed with strong setae; socii diverging and tapering to pointed apices
(42) *eupatoriella*
Harpe not abruptly widening at apex, apex rounded, scarcely lobed; socii broadly rounded (43) *polymniae*
15. Harpes sharply bent inward near apex, the pointed tips dark-pigmented; a median elongate pointed process (gnathos) 16
Harpes not sharply bent near apex; gnathos not differentiated 17
16. Socii large, broadly flattened (92) *disjuncta*
Socii smaller, incurved (91) *anaticula*
17. Vinculum a narrow almost thread-like band; anellus with lateral sclerotized rods 18
Vinculum not thread-like; anellus without lateral sclerotized rods (except in No. 85) 29
18. Apical margin of harpe evenly rounded 19
Apical margin of harpe with a small pointed projection 24
19. Harpes very slender, parallel-sided; aedeagus elongate, gradually tapering to the acuminate tip (78) *improvisa*
Harpes if slender toward base, then not parallel-sided; aedeagus if acuminate, not elongate 20
20. Aedeagus short, stout, abruptly contracting and bent dorsad to the acute tip 21
Aedeagus longer, and tapering to acute tip 22
21. Harpes and socii with long setae (67) *albertiella*
Harpes and socii with short setae (66) *packardella*
22. Vinculum curving posteriorly midventrally; harpes very broad
(79) *polytita*
Vinculum evenly convex or but slightly curving midventrally 23
23. Aedeagus widest beyond middle, thence tapering to acute tip; harpe with long setae (82) *paroptila*
Aedeagus abruptly tapering near tip; most of setae of harpe short
(83) *fugitans*
24. Pointed apical projection of harpe evident 25
Apical margin of harpe merely indistinctly angled by a slight projection
(84) *callistricha*
25. Aedeagus with conspicuous rounded bulges before the abruptly acute tip; socii widely separated (71) *trifasciella*
Aedeagus not or very slightly bulging before the acute tip 26
26. Aedeagus very slightly bulging before the acuminate tip; an elongate patch of minute cornuti (72) *quinquenotella*
Aedeagus not bulging before the acute tip; cornuti absent 27
27. Aedeagus abruptly curving dorsad near tip and tapering to the acute tip; tegumen sclerotized in a narrow band between socii .. (74) *zophopasta*
Aedeagus not abruptly curving dorsad; tegumen not as above 28

28. Aedeagus gradually tapering to the elongate acuminate tip . . (73) *domicola*
 Aedeagus abruptly tapering, not long acuminate before tip
 (76) *coronatella*, (77) *canadensisella*
29. Anellus with strongly sclerotized lateral arms; a ventral bilobed membra-
 nous flap before apex of aedeagus (85) *eugrapha*
 Anellus without sclerotized lateral arms; no such membranous flap of aede-
 agus 30
30. Lateral margins of tegumen modified 31
 Lateral margins of tegumen not modified 35
31. Tegumen expanding laterally into large broad wings . . (65) *sporobolcella*
 Lateral margins of tegumen not produced into broad wings 32
32. On margin of tegumen below each socius, a sharp curved hook
 (34) *ivella*
 No sharp curved hooks on tegumen 33
33. Socii decurrent on tegumen, thus appearing pendulous and directed ven-
 trally, posteriorly along margin of tegumen narrow transversely fur-
 rowed rods; transtilla present (35) *ambrosiaefoliella*
 Socii erect; transtilla absent 34
34. Tegumen below socii swollen, forming two setose lobes . . (55) *tridenticola*
 Tegumen incurved, forming two elongate lobes simulating arms of gnathos
 (11) *viguierae*
35. Anellus in general cone-shaped, broad, or broad at base or slender through-
 out, or rarely cylindric 38
 Anellus if present not as above 36
36. Anellus a sclerotized ring, aedeagus long and acuminate . . (80) *luteella*
 Anellus absent, or not differentiated 37
37. No definitive anellus, but the membrane minutely setose; aedeagus stout,
 aperture margined by toothed flaps (81) *recognita*
 Anellus absent, aedeagus narrow cylindric, enlarging to a bulbous base
 (89) *ainsliella*
38. Aperture of aedeagus elongate, emitting a long slender spine from its
 proximal angle (88) *locuples*
 No spine from aperture of aedeagus 39
39. Harpe broad basally, with heavy setae, abruptly contracting at middle and
 thence slender and parallel-sided (86) *cerina*
 Harpe if slender toward apex not abruptly contracting at middle (harpe
 may be slender throughout) 40
40. Aedeagus appearing as if jointed, with a slender apical section 41
 Aedeagus not appearing jointed 45
41. Slender apical section of aedeagus arising from a depression in the wider
 basal section 42
 Apical section of aedeagus arising from the convex end of the wider basal
 section (52) *salutatoria*

42. Socii elongate, three times as long as wide 43
 Socii shorter and broader, not over twice as long as broad 44
43. Socii widely separated, diverging (20) *tenebricosa*
 Socii widely separated, curving toward midline (22) *variabilis*
44. Tegumen between socii produced as a rounded lobe (19) *eurotiella*
 Tegumen not produced between socii (23) *separabilis*
45. Vinculum produced anteriorly into a long slender rod .. (30) *staintonella*
 Vinculum not thus produced 46
46. Harpe cylindric, terminating in a nearly circular flat setose area
 (15) *bicristata*
 Harpe not as above 47
47. Harpe at apex with a convex dorsal surface clothed with strong dark setae,
 a concave ventral surface with fine long setae (41) *seneciensis*
 Harpe not conspicuously modified or specialized 48
48. Socii very small, widely separated; aedeagus forked at tip, with opposing
 teeth (25) *evanescens*
 Socii variable in size, but never very small 49
49. Socii with short setae at apex, long decumbent setae below apex
 (37) *taeniola*
 Setae of socii not of two kinds 50
50. Socii long, densely clothed with long fine setae 51
 Socii if long, not thus clothed 52
51. Aedeagus long, gradually tapering to slender apex (6) *longula*
 Aedeagus short, wide-mouthed (7) *simulans*
52. Aedeagus straight or nearly so, gradually and evenly narrowing to tip, or
 gently curving from base to tip 53
 Aedeagus sinuate, or abruptly narrowing, or curled or bent near tip .. 70
53. Uncus present, erect, elongate tongue-shaped, densely setose
 (28) *flourensiae*
 Uncus absent 54
54. Tegumen very short, hence sinus between socii deep, socii elongate ... 55
 If sinus between socii deep, tegumen not short 56
55. Socii columnar, tegumen merely a narrow sclerotized band uniting their
 bases (41) *plucheae*
 Socii, two long curved connivent arms (12) *micropunctata*
56. Socii elongate, parallel, decurrent on tegumen; costa of harpe concave be-
 fore the sharp-pointed apex (39) *angustata*
 Socii if very long then diverging; if arising low on tegumen not decur-
 rent; apex of harpe not sharp-pointed 57
57. Apical area of harpe with short conical specialized setae 58
 Apical area of harpe with normal setae, setae if heavy not conical 65
58. Aperture of aedeagus with opposing teeth 59
 Aperture of aedeagus without opposing teeth 60
59. Socii slender, setae moderately long (1) *fusicola*
 Socii broader, setae shorter, subscaphium differentiated ... (5) *needhami*

74. Harpe with a distinct apical lobe delimiting cucullus 75
 Area of cucullus appearing merely as a narrowing of apex of harpe ... 77
75. Uncus present, a small sharp hook; cucullus a short abrupt lobe 76
 Uncus absent, cucullus a slender less abrupt lobe (51) *koebelella*
76. Aedeagus wide in basal half, thence abruptly and irregularly narrowing to
 the slender curved apex; basal sclerotization of tegumen with free
 arms (27) *floccosa*
 Aedeagus, beyond wide basal half, abruptly slender to the curved apex
 (57) *seorsa*
77. Uncus present, a slender setose hook; tegumen broad, parallel-sided
 (58) *angustisquamella*
 Uncus absent 78
78. Tegumen bulging before socii, then narrowing to socii 79
 Tegumen narrower, socii wider than tegumen before them 80
79. Socii small, margin of tegumen incurved at their bases (47) *divisa*
 Socii larger, margin of tegumen evenly sloping to their bases
 (49) *insolita*
80. Subscaphium a dorso-ventral plate (48) *illecebrosa*
 Subscaphium a spinulose strip 81
81. Tips of socii curved ventrad (50) *transversata*
 Socii curving toward midline (54) *arnicella*

*Key to the Species of Bucculatrix Based on Female Genitalia*⁴

A. Ovipositor of the normal lepidopterous form—two soft setose lobes (species 1–46, 65–99).

1. No specialized scales or scale tufts or patches on segment 8 or interseg-
 mental membrane 2
 Specialized scales, scale tufts or patches of specialized scales on segment 8,
 or on segment 8 and intersegmental membrane, or on segment 7 .. 21
2. No modification or lobing of lateral posterior margins of segments 7
 or 8 3
 Lateral posterior margins of segments 7 or 8 or both with acute projec-
 tions; anterior apophyses present 20
3. Without specialization in the region of the ostium; modifications if present
 merely sclerotizations of membrane of ductus bursae or ostium 4
 Curved processes from lateral margins of ostium 19
4. Ductus bursae scarcely widening before ostium, without sclerotization,
 only the margins of ostium sclerotized 5
 Ductus bursae widening before ostium, sclerotized before ostium, or with
 lateral sclerotized bands; or a broad sclerotized depression posterior
 to ostium 12

⁴ Omitted from the key: *niveella* Chambers, *parvinotata* n. sp., *micropunctata* n. sp., *bicristata* n. sp., *brunnescens* n. sp., *immaculatella* Chambers, *transversata* Braun, *litigiosella* Zeller, *eugrapha* n. sp., *cerina* n. sp., *disjuncta* n. sp.

5. Ostium at posterior margin of sclerotized basal half of segment 8
(97) *gossypiella*
Ostium at or near anterior margin of segment 8, or in intersegmental
membrane 6
6. Ostium widely flaring, broad saucer-shaped; depression spinulose
(41) *plucheae*
Ostium not widely flaring 7
7. Dorsal margin of ostium produced posteriorly 8
Dorsal margin of ostium not produced posteriorly; lateral margins may be
produced posteriorly 9
8. Dorsal posterior margin of ostium indistinctly lobed (3) *montana*
Dorsal posterior margin of ostium not lobed; dorsal membrane spinulose
(2) *solidaginiella*
9. Lateral margins of ostium somewhat produced (13) *inuitata*
Lateral margins of ostium not produced; ostium margin circular or nearly
circular 10
10. Regular spining of signum ribs interrupted at intervals by groups of large
spines (11) *viguierae*
Spines of ribs of signum of nearly even size 11
11. Ductus bursae forked in segment 7 (16) *cuneigera*
Ductus bursae not forked (1) *fusicola*
12. Ductus bursae expanded and parallel-sided before ostium; signum ribs ex-
tending posteriorly into ductus bursae for one-third its length
(95) *ilecella*
Not as above; signum wholly within bursa copulatrix 13
13. Ductus bursae with sclerotized ventral plate at or before ostium 14
Ostium opening into a broad, dorsally sclerotized depression; signum leaf-
shaped, composed of radiating ribs (40) *adelpha*
14. Sclerotized plate of ductus bursae relatively short, ostium thus appearing
saucer-shaped, cup-shaped or goblet-shaped 15
Sclerotized plate of ductus bursae not as above; elongate, broad, or pos-
teriorly produced 17
15. Ostium saucer-shaped (4) *magnella*
Ostium goblet-shaped or cup-shaped 16
16. Ostium goblet-shaped (5) *needhami*
Ostium cup-shaped (6) *longula*, (7) *simulans*
17. Ventral margin of ductus bursae produced posteriorly to an acute angle
(94) *pomifoliella*
Ventral margin of ductus bursae not produced 18
18. Ductus bursae abruptly enlarged and broad in segment 7, anteriorly den-
tate (33) *kimballi*
Ductus bursae sclerotized through segment 7, gradually widening to
ostium (32) *agnella*
19. Curved processes short; ductus bursae not sclerotized before ostium
(42) *eupatoriella*

- Curved processes branching toward apex; ductus bursae sclerotized before ostium; tergite of segment 8 specialized (38) *carolinae*
20. Lateral posterior margins of segments 7 and 8 sharply projecting; signum ribs radiating from median ventral area (91) *anaticula*
 Lateral posterior margins of segment 8 less sharply projecting; signum ribs diverging obliquely from median ventral line .. (93) *ceanothiella*
21. Ostium at the posterior margin of the sclerotized basal half of segment 8 22
 Ostium near middle of or near anterior margin of segment 8, or in inter-segmental membrane 24
22. Anterior apophyses present, well developed 23
 Anterior apophyses represented by curved processes; two setae on a dorso-lateral sclerotized surface near anterior margin of membranous section of segment 8 (99) *thurberiella*
23. Tergite of segment 8 with two anteriorly projecting lobes, and two tufts of hair-like scales (96) *quadrigemina*
 Ductus bursae expanding before ostium to nearly the width of the segment; lateral groups of setae at base of membranous posterior section of segment 8 (98) *sphaeralceae*
24. Lateral clusters of specialized scales on segment 8 the only such specialization 25
 Clusters of specialized scales if present on segment 8 not the only specialization; specializations may include specialized scales on segment 8, on intersegmental membrane, on segment 7, and membranous flaps ... 31
25. Ductus bursae without sclerotization, margin of ostium only sclerotized . 26
 Ductus bursae sclerotized to form cup-shaped ostium, or sclerotized in segment 7 28
26. Lateral clusters of scales directed midventrally (14) *seneciensis*
 Lateral clusters directed posteriorly, either hair-like or short 27
27. Bursa copulatrix very small, signum ribs very slender, with fine short spines and borne on a slightly sclerotized rugose surface (36) *pallidula*
 Bursa copulatrix not very small; signum ribs strong, spines heavy
 (10) *ochritincta*
28. Ductus bursae sclerotized at ostium and flaring cup-shaped 29
 Ductus bursae sclerotized in segment 7, not flaring 30
29. Lateral specialized scales short and margining sclerotized segment 8
 (17) *albaciliella*
 Lateral scales hair-like in a dense median tuft (18) *ochristrigella*
30. Lateral hair-scale clusters borne on rounded lobes of segment 8
 (34) *ivella*
 Lateral scale clusters borne on elongate wings of lateral margins of segment 8 (29) *franseriae*
31. Posterior lateral margins of segment 7 produced laterally or posteriorly into specialized lobes 32

- Posterior lateral margins of segment 7 not modified (slight lobes in No. 35) 35
32. Lobes of segment 7 flat plates, margined with short comb-like scales; ostium in a large deep chamber (22) *variabilis*
 Lobes of segment 7 not flat plates 33
33. Lobes rounded, clothed with short narrowly club-shaped scales; ostium in a deep chamber, one-half as deep as No. 22 (23) *separabilis*
 Lobes rounded, margined with slender hair-like scales, and overlying a tuft of specialized scales on intersegmental membrane; ostium in a furrow with strongly sclerotized sides 34
34. Signum ring longitudinally placed (19) *eurotiella*
 Signum ring transversely placed (20) *tenebricosa*
35. Near posterior margin of segment 8, a pair of membranous lobes, clothed with flattened wing-like setae (21) *cricameriae*
 No such lobes of segment 8 36
36. Lateral to ostium, a pair of internal curved sclerotized processes
 (30) *staintonella*
 No such internal processes 37
37. Free pigmented flaps arising lateral to ostium 38
 No such free flaps of segment 8 39
38. Free flaps tapering to slender base; dense patches of dark-pigmented scales lateral to ostium on intersegmental membrane (65) *sporobolella*
 Free flaps semicircular; no dense patches of scales on intersegmental membrane (35) *ambrosiaefoliella*
39. Lateral tufts of slender elongate scales on intersegmental membrane and on segment 8; signum leaf-shaped, composed of radiating ribs
 (39) *angustata*
 Not as above 40
40. Specialized scales margining sclerotized dorsal and ventral bands of the basal area of segment 8 (28) *flourensiae*
 No such sclerotized bands on segment 8 41
41. Segment 8 ventrally clothed and margined with clusters of specialized scales 42
 Segment 8 not clothed with clusters of specialized scales; specialized scales if present on segment 8 in defined groups 43
42. A pair of arcs of dark-pigmented small scales, curving outward and posteriorly from mid-anterior margin of segment 8 (26) *benenotata*
 No such dark-pigmented arcs (25) *evanescens*
43. On each side of ostium on segment 8, a large patch of minute specialized scales, with strongly sclerotized margin toward midventral line
 (27) *floccosa*
 Specialized scales if present on sternite of 8 not thus margined 44
44. Near each lateral margin of intersegmental membrane, a dense patch of minute dark scales in a more or less depressed pocket 45

- Patches of minute specialized scales if present on the intersegmental membrane not in lateral depressed pockets 49
45. Ostium in a shallow sinus, margined by a strongly sclerotized horseshoe-shaped structure (46) *sexnotata*
 No such horseshoe-shaped structure 46
46. Ostium in a large nearly circular depression in segment 8 .. (44) *speciosa*
 No such large circular depression 47
47. Ductus bursae opening into a broad heart-shaped depression
 (45) *subnitens*
 No such heart-shaped depression, ostium circular 48
48. Ventral posterior margin of segment 7 with lateral pointed projections; ductus bursae forked in segment 7 (43) *polymniae*
 Lateral margins of ostium produced into truncated flanges .. (37) *taeniola*
49. Ductus bursae several times the length of the body and coiled, and except in its posterior third, armed with rows of teeth; on anterior dorsal margin of segment 8, a mass of small specialized scales
 (89) *ainsliella*
 Ductus bursae short; segment 7 and intersegmental membrane overlying basal half of segment 8 50
50. Clusters, lines or masses of minute specialized scales attached at the anterior dorsal margin of segment 8 (*litigiosella* will fall under this heading) 51
 Without such groups of specialized scales 63
51. On each side of ostium on sternite of segment 8, a tuft of pigmented specialized scales 52
 No tufts of specialized scales attached to sternite of segment 8 on each side of ostium 58
52. Specialized scale patches on intersegmental membrane ventral to ostium . 53
 No specialized scale patches on intersegmental membrane ventral to ostium
 (78) *improvisa*
53. Specialized scales on the intersegmental membrane forming an arch or a broad arc 54
 Specialized scales on the intersegmental membrane in two tufts 56
54. Specialized scales forming a semicircular arch 55
 Specialized scales forming an arc, scales short (72) *quinenotella*
55. Scales of arch long, projecting beyond margin of segment 7; scales of tufts of sternite of 8 all alike (71) *trifasciella*
 Scales of arch shorter, scarcely projecting; scales of tufts of sternite of 8 of two kinds (79) *polytita*
56. Tufts on intersegmental membrane dense, connected by less closely placed scales (76) *coronatella*
 Tufts not connected 57
57. Tufts large, lateral to ostium (77) *canadensisella*
 Tufts small, placed midventrally (70) *ochrisuffusa*

58. A dense median tuft of specialized scales on intersegmental membrane 59
 No median tuft of specialized scales on intersegmental membrane; specialized scales forming an arch or an arc 60
59. Near posterior ventral margin of segment 7 on intersegmental membrane an arc of specialized scales; a mass of minute scales at anterior margin of tergite of segment 8 (73) *domicola*
 No such arc of specialized scales on intersegmental membrane; on anterior margin of tergite of segment 8, a short group of specialized scales, and anterior to it, on intersegmental membrane, a mass of small scales (74) *zophopasta*
60. Specialized scales on intersegmental membrane forming an acute arch .. 61
 Specialized scales on intersegmental membrane forming an arc 62
61. Specialized scales of the anterior dorsal margin of segment 8 cylindric, tapering to a conical apex; fringing scales of segment 7 of several sizes (68) *coniforma*
 Specialized scales of dorsal margin of segment 8 not as above; bursa copulatrix bilobed, the posterior lobe receiving the ductus seminalis
 (69) *platyphylla*
62. Arc of specialized scales long; apophyses long (84) *callistricha*
 Arc of specialized scales shorter; apophyses short (83) *fugitans*
63. Sternite of segment 7 strongly sclerotized and transversely wrinkled
 (90) *eclecta*
 Sternite of segment 7 not transversely wrinkled 64
64. Long specialized scales fringing the posterior margins of segment 7 the only specialized scales 65
 Specialized scale patches present on intersegmental membrane 66
65. A free pouch-like invagination of membrane within ventral margin of ostium (88) *locuples*
 No pouch-like invagination, margin of ostium and ductus bursae immediately before ostium armed with teeth (81) *recognita*
66. Specialized scales forming an arch or an arc on intersegmental membrane ventral to ostium 67
 Specialized scales grouped into two small tufts; ostium with pouch-like lateral expansions (80) *luteella*
67. Arch acute, dark-pigmented and conspicuous; ductus bursae dentate
 (66) *packardella*
 An arc or a low rounded arch on intersegmental membrane 68
68. A dentate sclerotized band near middle of ductus bursae .. (67) *albertiella*
 No such dentate band on ductus bursae 69
69. An arch, broad at ends, with several rows of scales (87) *copeuta*
 An arc of short broad specialized scales (82) *paroptila*

B. Segment 9 of abdomen modified; ovipositor modified, inner margins of lobes developed into rasping or cutting rods (species 47-64).

1. With a lateral depressed pocket of minute specialized scales on intersegmental membrane near anterior margin of segment 8 2
Without such a depressed pocket of minute specialized scales 5
2. With a narrow raised plate near each lateral margin of sternite of segment 8 (57) *seorsa*
Without such a raised plate 3
3. With lateral fan-shaped tufts of specialized scales on segment 8 or at margin of intersegmental membrane 4
Without such fan-shaped tufts; lateral ventral surface of segment 8 finely reticulate (58) *angustisquamella*
4. Fan-shaped tufts near anterior margin of segment 8 (55) *tridenticola*
Fan-shaped tufts near posterior margin of segment 8 (56) *spectabilis*
5. Sclerotized section of ductus bursae bending to the right 6
Sclerotized section of ductus bursae not bending to the right, but lying in median line 13
6. On each side of ostium, the inner margin of a rounded depressed area rises to form a narrow erect plate 7
Without such an erect plate 8
7. Ostium and sclerotized section of ductus bursae abruptly wide
(52) *salutatoria*
Ostium and sclerotized section of ductus bursae not abruptly widening
(51) *koebelella*
8. Ductus bursae opening into a deep broad depression with pointed flaring lateral margins (59) *columbiana*, (60) *sororcula*
Not as above 9
9. Ostium in a more or less funnel-shaped depression, with lateral obliquely flaring bands, sculptured or reticulate 10
Ostium not in a funnel-shaped depression; lateral bands transverse; a pair of circular spinulose areas on tergite of segment 8 (53) *leptalea*
10. Lateral bands sharply defined and parallel-sided; fan-shaped tufts of scales laterally on segment 8 11
Lateral bands not well defined 12
11. Sclerotized section of ductus bursae extending into segment 6
(48) *illecebrosa*
Sclerotized section of ductus bursae short, not extending anterior to segment 7 (49) *insolita*
12. A fan-shaped group of slender specialized scales near each lateral posterior margin of intersegmental membrane (54) *arnicella*
Without such tufts of specialized scales (47) *divisa*
13. Tips of ovipositor lobes prolonged into strongly sclerotized cutting points; segment 8 with latero-ventral scale tufts and lateral margining hair-scales (64) *latella*

- Inner margins of ovipositor lobes modified into rasping rods (typical of the subsection) 14
14. Posterior apophyses heavy, clavate, appearing as anterior prolongations of the sclerotized segment 9 15
- Posterior apophyses long and slender; on segment 8, lateral patches of specialized scales and midventrally a pair of reticulate patches
(61) *nigripunctella*
15. Segment 9 partially dark-pigmented; anterior lateral margins of segment 8 produced; a pair of midventral scale tufts and lateral to these a second pair (63) *enceliae*
- Segment 9 not dark-pigmented; no such elaborate scale tufts
(62) *atrosignata*

SECTION I

Species 1 to 16

In this section are included a number of species whose larvae, in-so-far as the life histories are known, are gall-formers or stem borers, feeding on various species of Compositae with the possible exception of *inusitata* new species, which is reported as "bred from *Juniperus communis*" (Brower). All are comparatively large species, the ground color of the fore wing (except in *cuneigera*) white or nearly white; the markings, if any, at least in part longitudinal. The largest species of the genus belong in this section, in wing expanse measuring up to 15 mm. Venation appears to be less stabilized than in the typical members of the genus. Figures 28, 29, 30, 30a illustrate variation within a species in this section.

Except in the most specialized species of the section, the genitalia are closely similar, but with slight and constant differences. The male genitalia are characterized by the (usually) broad harpes, their apices bearing heavy setae, often modified into short blunt cones, or long strong setae; socii usually arising low on the tegumen, often long and tending to diverge widely; aedeagus short cylindric or attenuated toward apex, often bearing opposing teeth at apex. The female genitalia are of a simple type, without specialization in the region of the ostium; rarely groups of specialized scales may be present on sternite of segment 8.

(1) *Bucculatrix fusicola* Braun (Figs. 3, 41, 58, 58a, 58b, 59, 59a.)

1920. *Bucculatrix fusicola* Braun, Ent. News XXXI: 76. Type ♀, Cincinnati, Ohio [A.F.B.Coll.].

Head white, middle of tuft sometimes with a faint ochereous tinge; antennae white, shading to pale fuscous toward the tips. Thorax and fore wings white, the wing (fig. 3) marked with ochereous streaks, which are sometimes slightly dusted with brown; a median streak from base, sometimes faint, extends nearly to the middle of the wing; a second streak lying below costa and arising at about basal third, is obliquely placed and curves slightly dorsad ending beyond the tip of the basal streak; just beyond middle of costa, a straight oblique streak from costa crossing the wing and meeting on the termen the end of a line of black scales which extends along termen to apex but does not extend outward through the cilia; beyond this streak an oblique patch of slightly brownish-dusted ochereous scales, its inner edge parallel to the preceding costal streak; a faint and somewhat irregular curved streak from mid-dorsum is marked on the fold by a few black scales; a line of black scales in the cilia from tornus to apex is slightly convex outwardly and meets the tip of the terminal row of black scales at apex. Cilia white, below apex faintly tinged with ochereous. Hind wings and cilia brownish ochereous. Legs white, tips of tarsal segments spotted with black. Abdomen whitish, shaded with fuscous.

Alar expanse 12 to 12.5 mm.

Male genitalia (figs. 58, 58a, 58b). Harpes broadly rounded, apical half setose, setae ranging from heavy short blunt conical at apical margin to longer and more pointed, and finally to slender hairs proximad; socii slender elongate, setae moderately long; aedeagus short, straight, with two pairs of opposing teeth at apex; scale sac present.

Female genitalia (figs. 59, 59a). Ostium circular, ductus bursae immediately before ostium minutely spinulose; signum a narrow oblique ring; spines of signum ribs short and curved.

Specimens examined.—3 ♂, 6 ♀.

OHIO: Cincinnati, ♀ type, May 24, 1919, rearing record B.1014; 1 ♂ paratype, June 16, 1906; 2 ♂, 4 ♀, rearing record B.1014, with dates of emergence from June 5 to June 22, 1920; 1 ♀, June 30, 1934 [A.F.B.Coll.].

The larvae form slender spindle-shaped galls (fig. 41) on stems of *Helianthus trachelifolius* Mill., usually toward the upper part of the stem. Galls vary in length and diameter from 2 cm. in length with a diameter of .5 cm. to 4 or 5 cm. in length with a correspondingly lesser diameter. Feeding is completed in the latter half of September, the larva hibernating in the gall through the winter, escaping in the spring through a minute circular aperture. The cocoon is blackish fuscous,

with five or six sharp ridges which stand out as pale lines; the smooth cocoon described for the type is abnormal.

This species is separated from its allies by the longitudinal ocherous streak below costa, which nowhere touches costa, and the configuration of the lines of black scales along termen.

The reared specimens and the two flown specimens listed above are the only representatives of this species I have seen. Most of the captured specimens referred to this species in the original description belong to the following species, *solidaginiella*, new species. The specimens identified by Breland and Schmitt in their paper on the "Biology of Two Sunflower Gall Makers" (Ent. News, LIX, pp. 225-234, 1948) as *B. fusicola* Braun are examples of *B. simulans*, new species, and are included in the type series of that species. The galls figured by these authors do not resemble those of *B. fusicola*.

(2) ***Bucculatrix solidaginiella*** new species

(Figs. 1, 2, 30, 30a, 62, 62a, 63, 63a, 63b.)

Head white, antennae white, shading outwardly to pale fuscous in darker-marked specimens. Thorax and fore wings white, the wings marked with pale ocherous to brownish ocherous streaks; a median streak from base to beyond one-third, usually broadening outwardly, but often faint or nearly absent; from basal third of costa an oblique streak, which may meet a second costal streak, slightly less oblique, which passes across the wing to a group of dark-tipped scales (rarely wanting) on termen; a third costal streak, less oblique than the second, crosses the wing to termen; from middle of termen, a line of dark-tipped scales extends to apex, and is continued as a brown hair pencil to the tips of the apical cilia, contrasting with the white costal cilia; cilia below apex brownish ocherous, with a line of dark scales which meets the apical brown pencil at about its middle; just within the dorsal margin and near its middle, rarely touching the margin, an ocherous streak, lying mostly in the fold and sometimes attaining the second costal streak near termen, is marked on the fold by a few black scales, absent in pale specimens. Hind wings and cilia brownish ocherous, slightly darker in the male. Legs, including tarsal segments, wholly whitish. Abdomen whitish.

Alar expanse 11 to 12.5 mm.

Male genitalia (figs. 62, 62a). Apical costal area of harpe with heavy blunt conical setae (fig. 62a); socii diverging, very long, slender, enlarged distally, arising remote from tip of tegumen; a slight sclerotization ventral to the alimentary canal suggests a rudimentary subscaphium; aedeagus straight, slender and tapering to tip. Scale sac present.

Female genitalia (figs. 63, 63a, 63b). Anterior ventral margin of ostium sclerotized, lateral margins produced posteriorly and converging, the area thus enclosed microscopically spinulose; ductus bursae expanding before ostium; signum a broad ring, somewhat narrower dorsally, near posterior end of bursa and slightly constricting it; ribs regularly or irregularly spined, spines short.

Type.—♂, C. Mo. (probably near St. Louis), on *Solidago*, 6/7, 85 (Miss Murtfeldt) and bearing the number 244 [U.S.N.M., Type No. 65013].

Allotype.—♀, same data as the type, except date of emergence 6/10, 85 [U.S.N.M.].

Paratypes.—36 ♂, 36 ♀, distributed as follows: 1 ♀, same data as the type [U.S.N.M.]; 2 ♂, 2 ♀, Missouri, labeled "on *Solidago*," June 6–9 (Murtfeldt Coll.) [Cornell U.]; 1 ♂, Putnam Co., Ill., June 25, 1950, "reared ex larva on *Solidago*" (M. O. Glenn) [U.S.N.M.]; 1 ♂, Decatur, Ill., June 17 [U.S.N.M.]; 8 ♂, 6 ♀, Cincinnati, Ohio, June 17 to July 8 (A. F. Braun) [A.F.B.Coll.]; 1 ♂, 1 ♀, Ft. Hill, Highland Co., Ohio, on *Solidago ulmifolia* Muhl., rearing record B.2169, dates of emergence June 10, June 11 [A.F.B.Coll.]; 3 ♀, Oak Station, Allegheny Co., Pa., June 25, July 14, July 18 (Fred Marloff) [A.F.B. Coll. and U.S.N.M.]; 1 ♂, Ocean View, Va. (W. D. Kearfott) [U.S.N.M.]; 8 ♂, 6 ♀, Essex Co. Park, N. J., June 29 to July 20 (W. D. Kearfott) [U.S.N.M.]; 2 ♂, Essex Co. Park, N. J., June 29, June 30 (W. D. Kearfott) [A.F.B.Coll.]; 1 ♂, 1 ♀, New Lisbon, N. J., June 24, June 26 (E. P. Darlington) [A.N.S.P.]; 1 ♂, Montclair, N. J., July 17 (W. D. Kearfott) [Cornell U.]; 1 ♂, E. Aurora, N. Y., July 25 (W. Wild) [Cornell U.]; 1 ♂, East River, Conn., July 10, 1909 (C. R. Ely) [U.S.N.M.]; 1 ♂, 2 ♀, Martha's Vineyard, Mass., July 1, 18, 28; 1 ♀, without data (F. M. Jones) [U.S.N.M.]; 1 ♂, 4 ♀, Barnstable, Mass., June 30 to July 11 (C. P. Kimball) [Kimball Coll.]; 1 ♂, Augusta, Maine, July 14 (A. E. Brower) [Brower Coll.]; 1 ♂, 1 ♀, without locality, Pergande 3397, "Solidago" [U.S.N.M.]; 1 ♀, White Pt. Bch., N. S., July 21, 1934 (J. McDunnough) [C.N.Coll.]; 1 ♀, Knowlton, Que., June 30 (J. McDunnough) [C.N.Coll.]; 2 ♀, Ottawa, Ont., June 13 (C. H. Young) [C.N.Coll.]; 1 ♂, 2 ♀, Vineland Station, Ont., July 12, 13, "host *Solidago*" (W. L. Putman) [C.N.Coll.]; 1 ♀, Bottineau, N. D. (C. N. Ainslie) [U.S.N.M.]; 2 ♂, 1 ♀, Bonneville, Clark Co., Wn., July 14, 15 (J. F. G. Clarke) [U.S.N.M.]; 1 ♂, Walla Walla, Wn., June 18 (J. F. G. Clarke) [U.S.N.M.].

The specimen in the National Museum chosen as the type bears a label "*Bucculatrix solidaginiella* Riley;" I am glad here to validate this manuscript name. Both the type and allotype are in unusually perfect condition.

A common and widely distributed species.

The larvae feed in the spring in the growing tips of young shoots of various species of *Solidago*, destroying the terminal bud, but barely

boring into the tip of the stem. It is probable that a mine on a leaf is made in the preceding late summer or early autumn, as has been recorded for *B. cuneigera* Meyr., which displays habits identical with this species. The surface of the white cocoon is roughened, but the ridges are obsolete in all examples I have seen. Figures 30, 30a show variations in venation of the fore wings.

This species has been confused with both *B. fusicola* Braun and *B. magnella* Chambers, and specimens are thus misidentified in collections. From *B. fusicola*, it is separated by the costal streak which arises on the costa at basal third, instead of lying below it as in *B. fusicola*, and by the wholly whitish legs. *B. magnella* is characterized by the dark longitudinal streak from base to termen.

(3) ***Bucculatrix montana*** Braun (Figs. 60, 60a, 61.)

1920. *Bucculatrix montana* Braun, Ent. News XXXI: 77. Type ♂, Mountain Lake, Virginia [A.F.B.Coll.].

Head white, a few fuscous hairs in the tuft; antennal stalk pale fuscous. Thorax and fore wings white, the fore wings marked with ocherous, more or less fuscous dusted, or sometimes dark fuscous streaks; from base of wing and lying above the fold, a more or less well defined basal streak (absent in the type) extends along the axis of the wing where in darker specimens it may join the apices of the three costal streaks; three equally spaced oblique costal streaks, the first before middle of costa and bending below costa to join in the middle of the wing the second costal streak which runs into some fuscous dusting on the termen, and just before its tip is marked with a few fuscous scales; from termen just before apex a streak of blackish fuscous scales, in line with the axis of the wing, extends to the tip of the apical cilia; from beyond middle of dorsum, a curved streak bending back along fold is marked, especially on the fold, with fuscous dusting. Cilia whitish, except just below the apical fuscous line; a fine line of scattered dark-tipped scales in the terminal cilia meets the fuscous apical line at a very acute angle at about half its length. Hind wings pale fuscous, darker in males, especially in dark-marked specimens. Legs pale ocherous, hind tarsal segments tipped with fuscous, except in the palest specimens. Abdomen ocherous, fuscous above in the middle segments in females, entirely fuscous in males.

Alar expanse 10.5 to 13 mm.

Male genitalia (figs. 60, 60a). Harpes small, swollen at base, tapering to narrow cucullus bearing short blunt conical setae; socii short setose, variable in length, somewhat enlarged distally and arising well before tip of tegumen; aedeagus long, tapering to the slender apex. Scale sac large.

Female genitalia (fig. 61). Ostium narrowly sclerotized anteriorly, produced posteriorly; signum as in *solidaginiella*.

Specimens examined.—43 ♂, 28 ♀.

VIRGINIA: Mountain Lake, ♂ type, June 18 [A.F.B.Coll.].

OHIO: Adams Co., 1 ♀, June 30, 1928 (A. F. Braun) [A.F.B.Coll.].

MICHIGAN: E. S. George Reserve, Livingston Co., 1 ♂, July 10, 1950 (Ralph Beebe) [A.F.B.Coll.].

NEW YORK: De Ruyter Res., Madison Co., 2 ♂, 1 ♀, July 4, 1922 (Crosby and Forbes) [Cornell U.].

GEORGIA: Charlton Co., 1 ♀, June 19, 1916 (Otto Buchholz) [A.N.S.P.].

NEW JERSEY: New Lisbon and Whitesbog, 4 ♂, June 22 to July 11 (E. P. Darlington) [A.N.S.P.]; Essex Co. Park, 1 ♂, June 29 (W. D. Kearfott) [Cornell U.].

CONNECTICUT: East River, 1 ♂, 1 ♀, July (C. R. Ely) [U.S.N.M.].

MASSACHUSETTS: Hyde Park, 1 ♀, July 8 (F. Haimbach) [A.N.S.P.]; Woods Hole, 1 ♂, July 18 [J. R. Eyer Coll.]; 1 ♂, July 18 [Cornell U.]; Barnstable, 15 ♂, 12 ♀, June 25 to July 14 (C. P. Kimball) [C. P. Kimball and A. E. Brower Coll.]; Martha's Vineyard (MV), 1 ♀, July 6 (F. M. Jones) [U.S.N.M.].

MAINE: Bar Harbor, 3 ♂, 3 ♀, July 10 to Aug. 3; Augusta, 1 ♂, July 30; Ashland, 3 ♂, 1 ♀, July 16 to 31 (A. E. Brower) [A. E. Brower Coll.].

ONTARIO: Bell's Corners, 2 ♂, June 16, 19 (G. A. Hobbs) [C.N.Coll.]; Ottawa, 1 ♀, July 15 (C. H. Young) [C.N.Coll.].

NOVA SCOTIA: Parrsboro, 5 ♂, 3 ♀, July 7 to 25 (J. McDunnough) [C.N.Coll.]; Petite Riviere, 1 ♂, July 15 (J. McDunnough) [C.N.Coll.]; Smith's Cove, 1 ♀, July 25 (J. McDunnough) [C.N.Coll.]; Baddeck, 1 ♀, Aug. 7 (J. McDunnough) [C.N.Coll.].

Food plant and early stages unknown. The type specimen emerged from a cocoon typical of the genus; cocoon reddish ochereous, with ten low ridges.

The distinguishing character of *B. montana* is the blackish streak extending in a line with the longitudinal axis of the wing from near apex of the wing to the tip of the apical cilia.

(4) ***Bucculatrix magnella*** Chambers (Figs. 6, 64, 64a, 65, 65a.)

1875. *Bucculatrix magnella* Chambers, Canad. Ent. VII: 54. Type ♀, Texas [M.C.Z., Type No. 1309].

Head white, tuft more or less mixed with reddish ochereous; antennal stalk fuscous. Thorax and fore wings white, the wing (fig. 6) marked with golden brown and blackish streaks; from base a longitudinal ochereous to dark brown streak, slightly darker along its costal margin, extends beyond the middle of the

wing, where in darker-marked specimens it is joined by an oblique blackish costal streak and curves downward to termen, thence following the margin of the wing to apex, and extending through the apical cilia; in paler specimens (δ paratype, U.S.N.M.) this oblique streak from costa to basal streak is indicated only by a faint line of scales (fig. 6), beyond this point as in darker specimens; lying above, parallel, and close to the outer part of the basal streak is a slender pale ocherous streak; arising on the dorsal margin opposite the oblique costal streak is a more or less distinct (sometimes absent) oblique straight dorsal streak, which meets the costal streak at the median basal streak, forming in dark-marked specimens, a conspicuous V; an irregular patch of dark-tipped scales on costa before apex; dark-tipped scales in cilia below apex. Hind wings varying from nearly white with white cilia (♀ paratype, U.S.N.M.) to brownish fuscous, with somewhat paler cilia. Legs whitish, tarsal segments tipped with blackish fuscous.

Alar expanse 12 to 14 mm.

Male genitalia (figs. 64, 64a). Setae of apical margin of harpe short blunt cones, proximad gradually more slender; socii long, arising distant from tip of tegumen, short setose; subscaphium defined; aedeagus wide proximally, rapidly tapering to slender apex; scales of scale sac long and slender.

Female genitalia (figs. 65, 65a). Ostium shallow cup-shaped, ventral half sclerotized, microscopically spinulose; signum a narrow ring, spines short.

Specimens examined.—2 δ , 5 ♀ .

TEXAS: ♀ type [M.C.Z.]; 1 δ paratype, labeled by Busck "undoubtedly one of Chambers' type specimens," "compared with type Cambridge," is here-with designated δ paratype [U.S.N.M.]; 1 ♀ paratype (without abdomen) labeled in Chambers' handwriting [U.S.N.M.].

MISSOURI (?): 1 ♀ (without abdomen), Coll. C. V. Riley [U.S.N.M.].

ILLINOIS: Chicago, 2 ♀ , July [U.S.N.M.].

FLORIDA: Lakeland, 1 δ , March, 1913 (C. N. Ainslie) [U.S.N.M.], in poor condition.

Food plant and early stages unknown.

This species is distinguished by the conspicuous median streak curving to termen beyond middle and following termen to apex.

The male paratype in the United States National Museum (fig. 6) agrees in fore wing markings more closely with Chambers' description than does the type at the Museum of Comparative Zoology. In general, females are more heavily marked than males. In the description of *magnella*, Chambers writes that in the hind wings "the apical vein goes to the apex, and the median vein gives off only a single branch, instead of two." In all specimens I have examined, the venation of the hind wings is typical of the genus, i.e., media is two-branched.

- (5) *Bucculatrix needhami* Braun (Figs. 5, 31, 42, 42a, 66, 66a, 67, 67a.)
1956. *Bucculatrix needhami* Braun, Ent. News LXVII: 69. Type ♂, Englewood, Florida [Cornell U., Type No. 3123]. Allotype ♀, Englewood, Florida [Cornell U., Type No. 3123].
1948. A Bucculatricid Gall and its hypermetamorphosis, James G. Needham, Journ. N. Y. Ent. Soc. LVI: 43-50.

Head white, tuft brown in the center; antennae pale gray. Thorax white, tegulae shaded with fuscous anteriorly. Fore wings white, marked with irrorated fuscous streaks which may vary in distinctness, or one or more of them be absent. In well-marked specimens, the following markings can be distinguished (fig. 5): a median streak from base broadening outwardly for about one-third the wing length, its broad portion ending before the black patch of slightly raised scales lying just below the fold; above the patch of raised scales this streak continues as an attenuated line to the middle of the wing; just posterior to the raised black scales, a broad streak, parallel to termen, extends to the end of the cell, meeting a small black spot; costad of the median streak, starting at basal fifth is a narrower streak, its point directed toward the small black spot at end of cell; below this streak there is usually a short fine fuscous line; beginning just beyond and below middle of costa is a more or less broad very oblique streak which extends into the apical area; apical costal area dusted with fuscous scales; scattered fuscous dusting along dorsal margin; scales along termen black-tipped and forming a more or less conspicuous cluster about half-way along the cilia; these scales extend along the wing margin to the apex, where the dark color is continued as a blackish pencil in the apical cilia; a line of slender finely dark-tipped scales near the base of the cilia extends parallel to termen, converging to apex. Hind wings pale gray, cilia rufous at base. Legs white, with fuscous shading, tarsal segments black-tipped. Abdomen whitish.

Alar expanse 13 to 15 mm.

Male genitalia (figs. 66, 66a). Harpes broad, parallel-sided; apical setae blunt conical, proximad slender conical; socii short, arising near tip of tegumen, setae short; subscaphium present; aedeagus with two pairs of opposing teeth near tip. Scale sac large.

Female genitalia (figs. 67, 67a). Ostium goblet-shaped, sclerotized, microscopically spinulose; signum a very narrow ring, ribs irregularly spined.

Specimens examined.—12 ♂, 10 ♀.

FLORIDA: Englewood, ♂ type, March 29, 1946, ♀ allotype, March 24, 1946; 3 ♂, 3 ♀ paratypes, April 5 to April 17 (J. G. Needham); Sarasota, 1 ♀ paratype, March 24, 1946 (J. G. Needham), all reared from galls on stem of *Helianthus agrestis* Pollard [Cornell U.]; 8 mi. W. of Moore Haven, Glades Co., 6 ♂, 3 ♀ paratypes, ex pupa, April 7 to May 17, galls on stems of *Helianthus agrestis* (C. L. Remington and L. Brass.) [Yale University].

KENTUCKY: Hiseville, Barren Co., 1 ♂, 1 ♀, paratype, imagoes June 3 and

June 12, 1941, from galls on stems of *Helianthus angustifolius* L., rearing record B.1853 (A. F. Braun) [A.F.B.Coll.].

ILLINOIS: Chicago, 1 ♀ paratype, VI.3.04 (G. McElhose) [U.S.N.M.].

NEW YORK: Karner, 1 ♂ paratype, April 21, 1903, "from gall on *Helianthus strumosus*" (N.Y.S.Coll.) [U.S.N.M.].

The galls occur on several species of *Helianthus*, and their size and shape appears to vary with the species of sunflower. Figure 42 shows a gall on *Helianthus agrestis* Pollard (*H. curtisii* Fernald). The following are a few excerpts from Dr. Needham's paper (cited above): "gall is a thickening of the walls of the stem, about an inch long and four-fifths as wide, and with a large oval cavity inside. It varies in form from oblong to almost round. It tapers a little more abruptly to the stem at the upper end." . . . "Galls occur singly on the stems; very rarely two, and when two, one or both are imperfectly formed. They are generally located somewhat below mid-height of the plant." In contrast on *Helianthus angustifolius*, the irregular galls occur amongst the inflorescence, the peduncles of the flower heads branching out from the gall. The gall may be quite slender when on an individual peduncle and up to as large or larger than that of *Gnorimoschema gallae-solidaginis* (Riley), when several peduncles branch from it. Full-grown larvae pass the winter within the gall, leaving in the spring by a small circular opening. The cocoon (fig. 42a) is marked by eight longitudinal ridges, the boundary between the posterior section and anterior one-third clearly defined.

In his paper on this species, Dr. Needham calls attention to the change from the inactive, legless and non-spinning larva (fig. 31) in the gall to the normal Lepidopterous type with prolegs and capable of spinning. These changes take place within the gall, preparatory to leaving it. "Here was a non-feeding instar, interpolated between larval and pupal stages: a clear case of hypermetamorphosis" (p. 45, *l.c.*).

The distinguishing characters of the wing markings are the longitudinal streaks, *i.e.*, a slender longitudinal discal streak parallel to the basal streak with a line of fuscous scales between it and the basal streak.

(6) ***Bucculatrix longula*** new species

(Figs. 68, 68a, 69, 69a.)

Head white, tuft with ochreous and brown hairs; antennal stalk whitish at base, shading outwardly to pale brownish and indistinctly annulate; antennal notch of male slight. Thorax white, tegulae anteriorly faintly yellowish. Fore

wings shining white, with pale ocherous marks, some of which may be faint or absent; from base along fold to two-fifths the wing length, a slender ocherous streak; a second longitudinal streak in the cell, arising just basad of the end of the first, extends nearly to the end of the cell; from three-fifths of costa, a narrow straight line of pale ocherous scales extends diagonally across the wing to tornus, at its costal end and at end of cell the scales are dark-tipped, at tornus meeting a larger group of more conspicuously dark brown-tipped scales; on costa midway between this diagonal line and apex, a group of pale ocherous narrowly dark-tipped scales; on middle of dorsum a pale ocherous oblique spot, bearing a group of blackish-tipped raised scales, sometimes the most conspicuous mark on the wing; from the group of dark-tipped scales at tornus, a line of dark-tipped scales along termen to apex; a second line of scales in the cilia, their dark tips lying near to and nearly parallel to the terminal row (less than one-third the length of the cilia from their bases) meets it at apex; cilia white. Hind wings and cilia white, faintly ocherous tinged. Legs ocherous, tarsal segments, especially of the fore and middle legs dark-tipped. Abdomen ocherous, grayish in the male.

Alar expanse 12 to 12.5 mm.

Male genitalia (figs. 68, 68a). Harpes nearly parallel-sided, apical area with short heavy conical setae; socii long, densely clothed with very long fine setae; membrane ventrad of the alimentary canal microscopically spinulose; anellus a slender cone; aedeagus long, tapering to slender apex, a pair of opposing teeth near mouth. Scale sac large, numerous small scales.

Female genitalia (figs. 69, 69a). Ostium goblet-shaped, microscopically spinulose; ductus bursae forked in segment 6 just before entering bursa; signum ribs variously spined, posteriorly usually one or more heavy spines, sometimes branched, grading to short or slender spines.

Type.—♂, Wilma, Whitman Co., Washington, 24.IV.34, reared from *Helianthus annuus* L. (J. F. G. Clarke) [U.S.N.M., Type No. 65014].

Allotype.—♀, same data as the type, except date of emergence 29.IV.34 [U.S.N.M.].

Paratypes.—3 ♂, 4 ♀, Wilma, Whitman Co., Washington, April 14 to 29, 1934; 1 ♂, Snake River, Whitman Co., Washington, 25.V.34; 1 ♂, Almota, Washington, 26.IV.34, all reared from *Helianthus annuus* L. (J. F. G. Clarke) [U.S.N.M.]; 1 ♀, Salt Lake, Utah, Jl. 18, 13, "from gall on *Helianthus*" (Timberlake Coll.) [U.S.N.M.].

The type series was reared from stem galls on *Helianthus annuus* L. The type and allotype display clearly all the marks mentioned in the description; in some specimens these marks are faint or obsolete.

The approximate and nearly parallel lines of dark-tipped scales along termen, the second near bases of the cilia, are distinctive of this species and also serve to separate it from the closely allied *B. simulans*

new species, and from *B. nivecella* Chambers. The fore wings are also more acute than in that species, and the whole aspect is different. The long slender aedeagus (checked by a second slide) of this species contrasts with the short wide-mouthed aedeagus of *B. simulans*. The very long, fine setae clothing the socii are characteristic of both *B. longula* and *B. simulans* and occur in no other species.

(7) ***Bucculatrix simulans*** new species (Figs. 70, 70a, 70b, 70c, 71, 71a.)

1948. *Bucculatrix fusicola* Breland and Schnitt (not Braun), Ent. News LIX: 225, 231-234.

Head white, tuft more or less mixed with brownish ochereous; antennal stalk white at base, shading outwardly to pale fuscous, antennal notch of male slight. Thorax white, tegulae posteriorly ochereous. Fore wing white, less lustrous than in *B. longula*, markings ochereous with the scales brown-tipped in the darker specimens; a longitudinal streak in fold from base for one-third the wing length; in the cell, and arising just basad of the end of the streak in the fold, a similar streak runs to the end of the cell, often meeting a straight diagonal line of scales crossing the wing from costa to tornus; this diagonal line broadens on costa, and at end of cell is marked by a group of more broadly dark-tipped scales, and at tornus meets a group of dark-tipped slightly raised scales; between the diagonal line and apex on costa, a patch of ochereous scales reaching half-way across the wing; dorsal margin near base sometimes pale ochereous, with rarely a few of the scales dark-tipped; beyond middle of dorsal margin a large patch of dark-tipped scales extends across the fold and bears on the fold a few blackish-tipped raised scales; from the group of dark-tipped scales at tornus, a line of dark-tipped scales along termen to apex; a second line of scales, their dark tips near middle of cilia at tornus, converges toward the first line, nearly or quite meeting it at apex; cilia white. In several of the type series, some of the markings described above are without dark-tipped scales, and some may be obsolescent. Hind wings and cilia pale ochereous. Legs pale ochereous, fore and middle pair shaded with fuscous, hind tarsal segments fuscous-tipped. Abdomen pale ochereous, with slight fuscous shading above in the male.

Alar expanse 9.5 to 10 mm.

Male genitalia (figs. 70, 70a, 70b, 70c). Differing from *B. longula* only by the short aedeagus, with wide mouth, and the number of opposing teeth near mouth, this number not constant in the species (figs. 70a, 70b, 70c); scale sac with numerous small scales.

Female genitalia (figs. 71, 71a). Scarcely distinguishable from the female genitalia of *B. longula*, except by characters of the signum; signum with spines longer and more slender, some of the ribs with one long spine and several very small spines (cf. fig. 69a).

Type.—♂, East St. Louis, Illinois, *Helianthus annuus* L., IV.4.30, issued V.22.30 (Webster Grove, No. 30019c, R. C. Lange Coll.) [U.S.N.M., Type No. 65015].

Allotype.—♀, same data as the type except Webster Grove No. 30019 [U.S.N.M.].

Paratypes.—1 ♂, East St. Louis, Illinois, "in stem gall, *Helianthus annuus*, IV.22.30, iss. V.21.30" (Webster Grove No. 30040, R. C. Lange Coll.) [U.S.N.M.]; 1 ♀, Fairmount, Illinois, "sunflower, 9.27.30, iss. VI.9" (Satterthwait Coll.) [U.S.N.M.]; 1 ♂, Austin, Texas, "sunflower, forms gall on stem, 1.6.39, em. 4.15.39" (Breland Coll.) [U.S.N.M.]; 4 ♂, 4 ♀, Austin, Texas, "summer '47, sunflower" (Schmitt Coll.) [U.S.N.M.].

In addition to the type series, there are two additional specimens (badly greased) from East St. Louis, with cocoons; also a gall with cocoon spun immediately above the gall.

The life history of this species is described and the galls and cocoons figured by Breland and Schmitt under the name *Bucculatrix fusicola* Braun. The galls are somewhat variable in shape (as figured) often appearing as a swelling on the side of the stem. The larvae become full-fed in the fall passing the winter in the larval state within the gall, leaving the gall to spin and pupate in the spring; a raised ring may encircle the exit hole of the larva. Cocoons are described by Breland and Schmitt as "white to a light gray color." Cocoons accompanying the types from Illinois are pale gray with eight to ten fine ridges, some of the lateral ridges anastomosing.

This species is very close to *B. longula*, but differs from it in the smaller size, less lustrous fore wing with less acute apex, and more distant and diverging ciliary lines. It is possible that *B. niveella* Chambers (described from Texas) is a nearly immaculate form of this species.

Five specimens (3 ♂, 1 ♀ [U.S.N.M.], 1 ♀ [A.F.B.Coll.] labeled "Colorado (G. Ainslie)," are doubtfully assigned to this species on the basis of the short aedeagus (fig. 70c). The aspect of these specimens, which are in poor condition, is that of *B. longula*, with which they agree in size and configuration of the ciliary lines.

(8) ***Bucculatrix niveella*** Chambers

1875. *Bucculatrix niveella* Chambers, Canad. Ent. VII: 54. Type locality, Texas (? Bosque Co., or Waco, McLennan Co.). Type not in existence.

I quote Chambers' description of this species. "Snow white, very faintly tinged with yellowish on the front of the tuft and in the apical part of the fore wings, and with a very few scattered brown scales in the costal ciliae, but with two distinct dark brown hinder marginal lines in the dorsal ciliae, one at their base, the other beyond their middle, slightly converging towards the apex. *Al. ex.* a little under half an inch."

It is possible that *niveella* is an immaculate form of the preceding species, described as *B. simulans*; in the latter species, the markings sometimes tend to be obsolescent. In the absence of the type, however, definite determination is impossible and *niveella* must be regarded as an unrecognized species.

(9) ***Bucculatrix parvinotata*** new species

(Fig. 72.)

Head white, tuft faintly ochereous in middle; antennal stalk shading outwardly to fuscous. Thorax white; fore wings white; three or four black scales in a line in the fold at two-thirds its length; a similar longitudinally placed line of scales at end of cell, and one or two such black scales at extreme apex; cilia white. Hind wings and cilia faintly ochereous tinged. Legs white, tarsal segments minutely dark-tipped.

Alar expanse 11 mm.

Male genitalia (fig. 72). Harpes concave inwardly, apically with short conical setae; socii moderately long, scarcely enlarging apically, setose; subscaphium undefined, membrane laterally microscopically spinulose; aedeagus slightly curved, gradually tapering. Scale sac bilobed by a median constriction, scales unpigmented.

Type.—♂, Mesilla Park, New Mexico, at light, May 8 (Ckl.) [U.S.N.M., Type No. 65016].

Food plant and early stages unknown.

The white fore wings, marked only with a few black scales characterize this species. *B. immaculatella* Chambers, described as "Silvery white, immaculate. *Al. ex.* 5/16 inch." is the only species of our fauna which approaches *B. parvinotata*. The type of *B. immaculatella* is apparently not now in existence; it however seems to be a smaller species.

(10) ***Bucculatrix ochritincta*** new species

(Figs. 73, 73a, 73b.)

Head white, tuft with a few fuscous hairs; antennae whitish, stalk darkening toward tip. Thorax creamy white. Fore wing shining creamy white, tinged with ochereous, especially in the fold; extreme costal margin ochereous to nearly half the wing length, where a very oblique and slender ochereous streak diverges from the costa; beyond this, a slightly less oblique and broader costal streak

crosses the wing to termen near tornus, there meeting a group of a few blackish-tipped raised scales; beyond this, a broad triangular ocherous spot is separated from the apex by a triangular creamy white area; from middle of dorsum a pale ocherous oblique streak bears a few blackish-tipped scales on its inner margin in the fold; at tornus a faint ocherous spot; from the group of raised scales on termen, a line of dark-tipped scales on termen to apex; costal cilia white, cilia below apex ocherous-tinged, and with a line of dark-tipped scales extending dorsad through them from a point opposite apex. Hind wings and cilia creamy white, except tip of wing and apical cilia ocherous. Legs pale ocherous.

Alar expanse 9.5 mm.

Female genitalia (figs. 73, 73a, 73b). Ventral margin of ostium sclerotized; signum a band narrow dorsally, ribs irregularly spined, some large strongly sclerotized spines, some minute spines; a tuft of long hair-like scales on a lateral depressed area of segment 8; scales on posterior margin of segment 7 long and hair-like.

Type.—♀, Fall Creek Falls State Park, Van Buren County, Tennessee, May 1, 1939 (A. F. Braun) [A.F.B.Coll.].

Food plant and early stages unknown.

Differing from all other species of this section by the creamy white fore wing, in contrast to the pure white wing of the related species.

(11) ***Bucculatrix viguierae*** new species (Figs. 4, 74, 74a, 75.)

Head white, tuft with a few ocherous hairs; eye-cap faintly ocherous tinged posteriorly, stalk whitish at base, shading outwardly to fuscous. Thorax white, shaded with pale ocherous anteriorly. Fore wing (fig. 4) lustrous white, with ocherous, mostly longitudinal markings, and a few groups of black-tipped scales; from base of costa to one-third wing length and adjacent to costa, a fine line of ocherous scales; from one-third of wing length and below costa, an ocherous streak to end of cell; from just below costa, at two-thirds, an oblique streak, marked on its costal end by a few dark-tipped scales, runs across the wing to a patch of black-tipped scales on termen; beyond this streak, a patch of a few dark-tipped scales on costa; from base of wing, an ocherous stripe, broadening outwardly, extends along the fold to beyond one-third; arising within the dorsal margin, basad of the costal streak and marked on the fold by a group of black-tipped scales, is an oblique dorsal streak, which meets the end of the longitudinal ocherous stripe lying below costa at the middle of the oblique costal streak; at apex from one to several black-tipped scales; from apex, a broken line of minutely dark-tipped scales extends through the terminal cilia. Hind wings pale whitish or grayish ocherous, cilia ocherous tinged. Fore and middle legs dark fuscous, hind legs ocherous, tarsal segments fuscous-tipped. Abdomen straw-colored, with fuscous shading posteriorly.

Alar expanse 11 mm.

Male genitalia (fig. 75). Harpes broadly rounded, nearly parallel-sided; socii short, setae moderate in length; tegumen incurved, forming two elongate lobes simulating arms of gnathos; aedeagus parallel-sided, curving slightly, produced proximally beyond the elongate aperture. Scale sac present, scales slender, tapering to a point.

Female genitalia (figs. 74, 74a). The usual unspecialized type, with ventral margin only of ostium sclerotized, ductus gradually widening to ostium, signum characteristic, spining of ribs various, ribs bearing some long, sharp-pointed, heavy spines, or more regularly spined with short and abruptly tapering spines (fig. 74a).

Type.—♂, Sierra Co., New Mexico, em. 27.IV.50 from gall on *Viguiera annua* (Jones) Blake (annual goldeneye) [Compositae], (E. J. O'Neal) [U.S.N.M., Type No. 65017].

Allotype.—♀, Sierra Co., New Mexico, em. 3.V.50 from gall on *Viguiera annua* (E. J. O'Neal) [U.S.N.M.].

Paratypes.—1 ♀, same data as type and allotype, except date of emergence 15.III.50 [U.S.N.M.]; 2 ♂, 4 ♀, Madera Canyon, Santa Cruz Mountains, Arizona, July 11, Aug. 3, Aug. 4 (R. W. Hodges) [Cornell U.]; 1 ♂, Pena Blanca Canyon, Santa Cruz County, Arizona (R. W. Hodges) [Cornell U.].

The markings of the fore wings of this species are somewhat similar to those of well-marked *B. simulans* and of *B. longula*, but without the ciliary lines of those species, and the aspect is different. It is abundantly distinct from either of these on characters of the male genitalia, viz. the peculiar incurved lobes of the tegumen and the sparser and shorter setae of the socii, the absence of teeth at tip of aedeagus; and in the female by the shape of the ostium, and the spining of the ribs of the signum.

(12) ***Bucculatrix micropunctata*** new species (Figs. 79, 79a, 79b.)

Face and tuft white; eye-caps white, antennal stalk white, with pale grayish ochereous annulations. Fore wings elongate, acuminate, apex upturned; white, marked with two longitudinal lines of black dots and groups of very pale ochereous minutely brown-tipped scales; before middle of costa an oblique group of brown-tipped scales; a second more open patch beyond middle; an elongate black spot at end of cell and immediately beyond it, a transverse pale ochereous spot, in which the scales are almost microscopically brown-tipped; an occasional black-tipped scale in the costal cilia, and irregularly placed black-tipped scales in the white apical cilia; the fold faintly yellowish, immediately above the fold and parallel to it, a line of almost evenly spaced black dots, and below fold, a line of similar black dots, irregularly spaced; beyond middle of dorsum, a large patch of pale ochereous scales, some of which are black-tipped. Hind wings pale

grayish white, cilia white. Legs white, fore and middle tibiae shaded with fuscous, tarsal segments narrowly fuscous-tipped.

Alar expanse 8 mm.

Male genitalia (figs. 79, 79a, 79b). Harpes broadly rounded at apex, with strong conical setae; socii very long and slender, connivent, setose, an oval apical area with heavier setae; anellus a slender tapering cone, lobed at tip; aedeagus long, slender, gradually tapering, aperture elongate with paired sclerotized teeth basad; vinculum broad, well sclerotized, two minute latero-posterior projections. Scale sac small.

Type.—♂, Needles, California, 16 April, 1918 (J. Ch. Bradley) [Cornell U., Type No. 3641].

Food plant and early stages unknown.

Known only from the male type, in perfect condition. In the absence of any knowledge of larval habits, this species is placed in this section on the basis of the long socii, and broad harpe with heavy conical setae.

Although the moth somewhat resembles *B. eurotiella* Wlsm. and *B. latella* Braun, the slender acuminate wings and the very different genitalia at once separate it from those species.

(13) ***Bucculatrix inusitata*** new species (Figs. 76, 76a, 76b, 76c, 77, 77a.)

Head white, tuft with a few brownish hairs; antennal eye-cap white, stalk pale grayish ochreous, darker toward tip, antennal notch deep. Thorax white. Fore wings lustrous white, markings ochreous, the scales usually more or less broadly dark-tipped; from just beyond base to one-third, a pale longitudinal streak, often faint or absent, its inner margin lying along the fold; from basal third of costa, an oblique streak curving outward below costa, and usually meeting a second oblique costal streak attenuated below costa and extending as a narrow line across the wing to a small group of black-tipped raised scales on termen near tornus; at two-thirds of costa, an irregular spot of variable size, its dark-tipped scales often encroaching on a triangular more or less conspicuous white area immediately before apex and partially in the cilia; this triangular area extends across the wing to the group of dark-tipped raised scales near tornus, and along its outer margin the smooth lustrous white scales of the general ground color form a narrow, almost iridescent bar lying alongside of the black-tipped scales which margin the termen; a second line of scales in the cilia, their dark tips at about basal third of cilia and curving inward near apex toward the terminal line of black-tipped scales; from middle of dorsum a more or less distinct oblique streak, marked on the fold by one to several black-tipped scales (sometimes absent), curves to the middle of the wing; from tornus, a faint nearly erect line of scales, often absent, crosses the wing to the oblique transverse line of dark-tipped scales; cilia white before apex, fuscous tinged

opposite apex shading to white at tornus. Hind wings and cilia grayish ochereous. Legs dull ochereous, shaded with fuscous. Abdomen in female ochereous, in male fuscous, except anal tuft.

Alar expanse 9.5 to 10 mm.

Male genitalia (figs. 76, 76a, 76b, 76c). Harpes bilobed on inner side at apex, the lobes with heavy setae, sinus between them unarmed; socii long, slightly enlarging at apex and here with sparse slender setae, proximad of apex, setae short and curved; subscaphium strongly sclerotized, long ciliate; free arms of gnathos long, slender, short setose on their basal half; anellus an elongate cone; aedeagus tapering to the slender tip. Scale sac present.

Female genitalia (figs. 77, 77a). Ovipositor lobes sparsely long setose; ostium unspecialized; ductus bursae forked in segment 7, the forks entering bursa dorsally near its posterior end; signum a ring broad ventrally, narrow dorsally, spines long and slender.

Type.—♂, Hull, Quebec, 13.VI.1955 (G. G. Lewis) [C.N.Coll., Type No. 7175].

Allotype.—♀, Wakefield, Quebec, 25.VI.1946 (G. S. Walley) [C.N.Coll., Type No. 7175].

Paratypes.—1 ♂, Bobcaygeon, Ont., 26.VI.1932 (J. McDunnough), 2 ♂, Hull, Que., 13.VI.1955 (G. G. Lewis), 1 ♂, 1 ♀, Ottawa, Ont., 23.VI.1955 (G. G. Lewis) [C.N.Coll.]; 1 ♂, Bar Harbor, Maine, July 16, 1938 (A. E. Brower), 1 ♂, Bar Harbor, Maine, emgd. June 22, '50, "bred ex *Juniperus communis*" (A. E. Brower), 1 ♂, Mt. Desert Is., Me., July 2, '34 (A. E. Brower), 2 ♂, 2 ♀, Augusta, Maine, June 27 to Aug. 3 (A. E. Brower) [A. E. Brower Coll.]; 17 ♂, 3 ♀, Barnstable, Mass., June 25 to July 13 (C. P. Kimball) [C. P. Kimball Coll.]; 2 ♂, Monroe Co., N. Y., June 23 and July 4 (C. P. Kimball) [C. P. Kimball Coll.]; 1 ♂, 1 ♀, New Lisbon, N. J., June 11 and June 18 (E. P. Darlington) [A.N.S.P.]; 1 ♀, Essex Co. Pk., N. J., June 20 (W. D. Kearfott) [U.S.N.M.]; 1 ♂, 1 ♀, Edge Hill, Pa., June 23 (F. Haimbach), 1 ♂, Fairm't, Phila., Pa., June 9 (F. Haimbach), 1 ♂, Roxborough, Pa., June 26, (F. Haimbach) [A.N.S.P.].

Only those specimens in which the distinctive characters of the wing markings are recognizable are included in the type series. In addition, 14 others, mostly from Maine and Massachusetts, representing both sexes have been examined. These can of course be recognized by the characteristic genitalia, especially of the male.

No data are available on the early stages of this species. One of the paratypes cited above from Bar Harbor, Maine, bears the notation "Bred ex *Juniperus communis*." Dr. Brower has assured me that such a label indicates that the specimen was actually reared from larva. Any conifer, particularly an evergreen species, would seem to be an

unusual food plant for a species of *Bucculatrix* placed in this section on wing markings and genitalia. It may not be correctly placed in this section.

The series of specimens from Ontario and Quebec, from which the type and allotype were selected are in exceptionally perfect condition. The best distinguishing wing characters of the species are the pure white triangular costal area before apex, and especially, the narrow lustrous white bar along termen, which stands out sharply when light strikes it at an angle. The remarkable development and specialization of subscaphium and gnathos is unique in this section and exceptional in the genus.

(14) ***Bucculatrix seneciensis*** new species (Figs. 80, 80a, 80b, 81, 81a, 81b.)

Head white, antennal stalk whitish, annulate with pale fuscous. Thorax white. Fore wings white; basal fifth of fold shaded with pale yellowish, a few of the scales sometimes narrowly dark-tipped; at two-fifths the wing length, sometimes a faint yellowish tinge, with a few of the scales below costa minutely dark-tipped; at three-fifths, a more conspicuous pale yellowish group of scales, minutely dark-tipped; a transverse band of dark-tipped scales from costa to tornus, leaving the extreme apex of wing white; at end of cell, a more or less conspicuous spot, the scales dark-tipped; on middle of dorsum, and extending across the fold, an irregular pale yellowish spot, at least some of its scales broadly dark-tipped; cilia pure white with a line of dark-tipped scales from tornus, sometimes encircling the apex, sometimes broken on costa. Hind wings white in female, very pale ochreous in male, cilia white. Legs ochreous, fore and middle tibiae outwardly fuscous, hind tarsal segments fuscous-tipped. Abdomen white, more or less shaded with pale fuscous.

Alar expanse 10 to 10.5 mm.

Male genitalia (figs. 80, 80a, 80b). Harpe proximad parallel-sided, expanding at apex to a convex dorsal surface clothed with a dense mass of black setae, a concave ventral surface clothed with fine long setae; socii very long, slender, setose for most of their length, meeting at an acute angle in the median line, tegumen extending far beyond their bases and terminating in a rounded point; a sclerotized strip on each side of the tube containing the alimentary canal; anellus broad conical; vinculum triangular; aedeagus with entrance of penis elongate, mouth elongate, slightly spiral. Scales of scale sac hair-like.

Female genitalia (figs. 81, 81a, 81b). Ostium at anterior margin of segment 8, its ventral margin only sclerotized; on segment 8 ventro-lateral groups of narrow specialized scales curving toward the mid-ventral line; bursa copulatrix elongate, extending anteriorly into segment 2; signum constricting the bursa, broken dorsally, ribs long ventrally and crowded together, short toward dorsum.

Type.—♂, Mint Canyon, Los Angeles Co., California, larva on *Senecio* sp., emdg. April 30, 1939 (J. A. Comstock) [Los Angeles County Museum].

Allotype.—♀, same data as the type, except date of emergence May 2, 1939 [Los Angeles County Museum].

Paratypes.—1 ♂, 3 ♀, same data as type and allotype, except dates of emergence April 26 to May 1 (J. A. Comstock) [L. A. Co. Museum]; 6 ♂, 1 ♀, Lovejoy Buttes, Los Angeles Co., California (Lloyd M. Martin) [L. A. Co. Museum]; 1 ♀, Olancho, Inyo Co., California, June 16, 1917 (G. R. Pilate) [A.F.B.Coll.]; 7 ♂, 1 ♀, Olancho, Inyo Co., California, June 8–15, June 16–23 [U.S.N.M.]; 1 ♀, La Puerta Valley, South. California, June 1–7 [U.S.N.M.]; 1 ♂, Havilah, California, June 1–7 [U.S.N.M.].

This species is probably a stem borer in the larval state. The white cocoon is slightly rugose, but lacks the typical ridges. The harpes of the male genitalia at once separate *seneciensis* from all other species.

B. seneciensis new species and *B. eurotiella* Wlsm. were reared at the same time from *Senecio* sp.; in the series reared by Lloyd M. Martin, cocoons of the latter are associated with some of the specimens of *B. seneciensis*.

(15) ***Bucculatrix bicristata*** new species

(Fig. 78.)

Head white, tuft faintly ocherous, eye-caps distally broad, antennal stalk shading to pale grayish ocherous outwardly. Thorax white, faintly ocherous anteriorly. Fore wing elongate, white with ocherous-fuscous marks; from base a pale fuscous streak, broadening outwardly, its inner margin lying along the fold to one-third the wing length, here diverging and curving to the middle of the disc, thence extending as a narrow line of scales to termen near tornus, where it meets a patch of large, black-tipped raised scales; from near middle of costa, a very oblique streak, broadest on costa and soon attenuated to a narrow line of scales, runs across the wing to the above patch of raised scales; beyond this on costa, a triangular patch of scales, its broad base on costa, and near its inner margin bearing a group of raised scales; from near middle of dorsum, a short, curved, oblique streak; from the patch of raised scales on termen, a line of dark scales extends along termen to apex and to the tips of the apical cilia; from this line dark-tipped scales extend into the cilia of termen. Hind wings pale brownish ocherous, cilia whitish toward tips. Legs whitish, tarsal segments black-tipped. Abdomen whitish beneath, grayish ocherous above.

Alar expanse 14 mm.

Male genitalia (fig. 78). Harpe cylindrical, terminating in a nearly circular flat area, which is evenly and closely clothed with heavy short setae the outer row of which margins the flat area; socii with short setae; subscaphium defined, microscopically setose and terminating posteriorly in a strongly sclerotized point; aedeagus tapering to a point. Scale sac transversely oval, scales slender.

Type.—♂, St. Petersburg, Florida, May [U.S.N.M., Type No. 65018].

Paratypes.—1 ♂, same data as the type [U.S.N.M.]; 1 ♂, Billy's Island, Okefenokee Swamp, Georgia, June, 1912 [Cornell U.].

Food plant and early stages unknown.

The configuration of the long median basal streak is similar to that of *B. magnella* Chambers; in *magnella* however there is an additional slender longitudinal streak lying close to and parallel to the conspicuous longitudinal streak. The conspicuous patch of raised scales on termen and the raised scales on costa (both of which are easily lost) and the remarkable and unique harpe separate this species from all others of the section. The male paratype from Okefenokee Swamp lacks the terminal segments of the abdomen.

- (16) ***Bucculatrix cuneigera*** Meyrick (Figs. 28, 29, 44, 44a, 44b, 82, 82a, 83.)
 1919. *Bucculatrix cuneigera* Meyrick, Exot. Microlep. II (Pt. 9): 288. Type, Muskoka, Ontario [B.M.].
 1920. *Bucculatrix errans* Braun, Ent. News XXXI: 77, 78. Type ♂, Cincinnati, Ohio [A.F.B.Coll.].
 1927. *Bucculatrix cuneigera* Braun, Trans. Amer. Ent. Soc. LIII: 195.

Head white, tuft either entirely white or more or less mixed with dark brown centrally; antennal eye-cap white, stalk pale ochreous to fuscous. Thorax, including tegulae, usually pure white, tegulae dark brown in those specimens in which the base of the wing below the fold is dark brown. Fore wings dark brown or almost black with white marks; from base of wing and just within the costal margin, an outwardly broadening white streak, its costal edge close to costa, its outer margin oblique, extends in the disc nearly to middle of wing; base of wing below fold usually white, the white area sometimes expanding, spreading outwardly and costad, or base of wing below fold sometimes wholly dark brown; at middle of costa, an oblique, triangular or outwardly curving white spot; basad of it, on dorsum, a larger half-crescent shaped mark; a narrow oblique costal streak at two-thirds, and opposite it at tornus, a pair of white spots narrowly separated by ground color, the outer of which is directed inwardly; a triangular white spot near apex and mostly in the costal cilia, bordered outwardly by an oblique dark line running to the tip of the apical cilia; a few black scales at apex form an irregular apical dot; cilia opposite apex ochreous, shading to fuscous at tornus; a line of dark-tipped scales through the middle of the cilia from apex to tornus. Hind wings dark brownish or blackish gray, cilia concolorous. Legs, except tarsal segments, dark brown outwardly. Abdomen dark fuscous, anal tuft pale.

Alar expanse 9 to 10.5 mm.

Male genitalia (figs. 82, 82a). Harpes with heavy conical setae at apex; socii with some short, some longer setae; subscaphium strongly sclerotized; aedeagus slender, entrance of penis elongate; vinculum narrow, emarginate. Scales of scale sac elongate (fig. 82a).

Female genitalia (fig. 83). Ostium unspecialized, ductus bursae forked in segment 7 at inception of ductus seminalis, the forks uniting again just before entering bursa copulatrix; signum ring wide ventrally, narrow dorsally.

Specimens examined.—31 ♂, 21 ♀.

ONTARIO: Muskoka, 1 ♀, July, 1918 (ex type series of *cuncigera*) [A.F.B. Coll.]; Ottawa, 2 ♂, 2 ♀, July 3 to July 10 (C. H. Young) [C.N.Coll.]; Bobcaygeon, 1 ♀, 29.VI.31 (J. McDunnough) [C.N.Coll.].

OHIO: Cincinnati, 1 ♂ (type of *errans* Braun), 10 ♂, 7 ♀ (paratypes of *errans* Braun), May 12 to May 28, rearing record B.977; 2 ♂, 2 ♀, June 5, 1918 (A. F. Braun) [A.F.B.Coll.]; 2 ♂ (paratypes of *errans* Braun), May 26, May 27, rearing record B.977 (A. F. Braun) [U.S.N.M.]; 2 ♀ (paratypes of *errans*), May 28, rearing record B.977 (A. F. Braun) [A.N.S.P.].

NORTH CAROLINA: Balsam, 1 ♂ (worn), July 23, 1911 [A.F.B.Coll.]; Highlands, Macon County, 3865 feet, 6 ♂, 5 ♀, June 24 to July 11, 1959, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

NEW YORK: E. Aurora, 1 ♀, July 3 (W. Wild) [Cornell U.].

MASSACHUSETTS: Barnstable, 1 ♂, July 11, 3 ♀, June 26 to July 2 [C. P. Kimball Coll.].

MAINE: Augusta, 1 ♀ (only head, thorax and one fore wing), July 24, 1947 [A. E. Brower Coll.].

NEW BRUNSWICK: St. Andrews, 1 ♂, 4.VII.1936 (T. N. Freeman) [C.N. Coll.].

NOVA SCOTIA: Parrsborough, 1 ♂, 4.VII.1914; Smith's Cove, 3 ♂, 1 ♀, 19.VII.1945; White Pt. Bch., Queens Co., 1 ♂, 20.VII.1934; Petite Riviere, 1 ♂, 1 ♀, 11.VII and 16.VII.1935; Baddeck, 1 ♂, 24.VI.1936 (J. McDunnough) [C.N.Coll.]; Annapolis, 1 ♂, 21.VI.1946 (McD. and Ferguson) [C.N.Coll.].

PRINCE EDWARD ISLAND: Prackley Beach Can. Nat. Park, 1 ♀, 24.VII.1940 (G. S. Walley) [C.N.Coll.].

QUEBEC: Knowlton, 1 ♂, 11.VII.1929 (J. McDunnough), 1 ♂, 1 ♀, 30.VI, 1.VII.1936 (G. S. Walley) [C.N.Coll.]; D. Golf Club, 1 ♂, 15.VII.1925 (F. P. Ide) [C.N.Coll.]; Newago, Lake St. Francis, 1 ♂ (H. S. Parish) [Cornell U.].

The type series of *errans* was reared from larvae feeding on *Aster shortii* Lindl. Although no specimens except this type series have been reared, other species of *Aster* replace *Aster shortii* as a food plant in the more northern localities. On *Aster shortii*, the larva makes a long contorted and sometimes spiral mine, which becomes noticeable on the

leaf in autumn (fig. 44). In early November, in a slight enlargement at the end of the mine, the larva spins a flat circular yellow wintering cocoon (fig. 44a), similar in appearance to the moulting cocoon of other species, but of dense texture, within which it lies curled during the winter. In March of the following year, it leaves this cocoon by a circular opening, and bores into a growing shoot just below the tip, hollowing out the stem, and killing the top of the shoot. It feeds downward, usually eating out the contents of the stem for about an inch; when full-grown it escapes by a circular hole near the lowest part of the burrow. The cocoon (fig. 44b), which is white or pale yellowish, with seven or eight low ridges, is spun on dead stems and twigs lying near the food plant, but apparently never on the food plant. Of the innumerable mines which may be present on a plant, often a half dozen to a single leaf, only some four or five can survive on the few shoots of the plant in the spring.

In *cuneigera*, the dark markings corresponding to the ocherous or dark-dusted markings of other species of the section have so greatly expanded as to become the apparent ground color, here so considered; the white marks correspond to the white ground of the other species, here greatly reduced in extent.

The ground color of the specimens from Highlands, North Carolina is dark blackish brown, almost sooty black; these specimens agree more closely in coloration with the specimen from the type series of *cuneigera* (cited above).

SECTION II

Species 17 to 64

Nearly one-half of the North American species are assigned to this section. Members of the plant family Compositae are hosts to all species whose food plants are known with the exception of *Bucculatrix pallidula* new species and *B. taeniola* new species, both of which are reported on members of the Labiatae. Within this section the greatest variety and specialization of genitalia are seen (Plates XIV to XXXII). In the male, shape and armature of the harpes and socii, and shape of the aedeagus vary. The cucullus of the harpe is often defined by specialized setae, sometimes modified into short blunt cones (figs. 99, 100, 105, 108, 116, 168). The presence of such conical setae may be taken

as a diagnostic character indicating assignment to this section and the probability of a Composite food plant. Such setae are however commonly present in members of Section I, also Composite feeders. The harpe may show a slight indication of lobing (figs. 127, 130, 134) or finally may be almost divided (fig. 108). The female genitalia show development from a comparatively simple unspecialized type to a highly specialized type culminating in the modification of the inner margins of the ovipositor lobes into rasping rods, and the transfer of the function of the ovipositor to the vagina with its specialized vaginal setae (Braun, 1958). Other specializations of the female genitalia include tufts or patches of specialized scales on segment 8 and on the intersegmental membrane (Plates XXI, XXIII, XXIV, XXVIII, XXIX, XXXII) or sclerotized outgrowths on segment 8 (Plates XXI, XXVI, XXVII, XXVIII).

On the basis of the structure of the ninth abdominal segment of the female, the section is divided into two subsections.

Subsection A.—Species 17 to 46. Segment 9 of the abdomen of the female not modified; ovipositor typical, consisting of two soft hairy lobes (Plates XIV to XXIV).

Subsection B.—Species 47 to 64. Segment 9 of the abdomen of the female modified; inner margins of the ovipositor lobes developed into rasping rods or cutting points, remaining areas of the ovipositor lobes flattened and fused with the membranous portion of the ninth segment; the exerted vagina, with its specialized vaginal setae, functions as an ovipositor (Plates XXV to XXXII).

Subsection A

(17) ***Bucculatrix albaciliella*** Braun (Figs. 86, 87, 87a.)

1910. *Bucculatrix albaciliella* Braun, Ent. News XXI: 175. Type ♂, Mills College, Alameda County, California [A.F.B.Coll.].

Face and tuft white, the tuft with a few ochereous hairs centrally; eye-caps white, stalk gray, antennal notch slight. Thorax and fore wings snowy white. Fore wings marked with pale ochereous, often faint, spots and streaks; a short streak in fold near base; a small spot just within the costa before middle of wing, a similarly placed, but larger and slightly oblique spot just beyond middle of wing which is in line with an oblique transverse spot running into the termen and is sometimes faintly connected with it; opposite the space between the two costal marks, a short streak in fold; a few ochereous scales on costa before apex;

cilia white. Hind wings, especially in male, faintly tinged with gray, cilia white. Legs whitish, tibiae and tarsi shaded with gray. Abdomen very pale grayish ochereous.

Alar expanse 8 to 9 mm.

Male genitalia (fig. 86). Setae of harpe short and heavy toward apex; socii widely separated, short, setose; anellus conical, abruptly contracting above middle; aedeagus slender toward tip, entrance of penis elongate. Scale sac small.

Female genitalia (figs. 87, 87a). Ovipositor two soft lobes; ostium in a broad cup-shaped depression; sclerotized basal half of segment 8 clothed laterally with short slender scales, an oval hyaline spot near anterior lateral angle; ductus bursae slender and membranous throughout, signum a very obliquely placed ring, ribs long-spined.

Specimens examined.—6 ♂, 4 ♀.

CALIFORNIA: Mills College, Alameda County, ♂ type, May 11, 1908, 4 ♂, 3 ♀ paratypes, May 11 and May 20 (G. R. Pilate) [A.F.B.Coll.], 1 ♂, 1 ♀ paratypes, May 11 and May 20 (G. R. Pilate) [U.S.N.M.].

Food plant and early stages unknown.

The markings suggest a close relationship to *B. ochristrigella* Braun, which is confirmed by the similarity of genitalia in both sexes. Superficially *albaciella* is easily distinguished from *ochristrigella* by its snowy white color and minor details of wing markings.

(18) ***Bucculatrix ochristrigella*** Braun (Figs. 27, 84, 85, 85a.)

1910. *Bucculatrix ochristrigella* Braun, Ent. News XXI: 175. Type ♂, Mills College, Alameda County, California [A.F.B.Coll.].

Face and head creamy white, a few grayish brown hairs in the tuft; eye-caps small, with a median ochereous stripe, antennal stalk gray, faintly narrowly paler annulate. Thorax creamy white, anterior margin of thorax and tegulae pale ochereous. Fore wings creamy white marked with pale ochereous spots and streaks; a narrow streak along basal third of costa; along fold a basal streak broadening outwardly and reaching nearly to one-third; before middle within the costal margin, an elongate patch; beyond middle, an oblique streak from costa to the middle of termen, opposite its end the cilia of termen are brown-tipped; a small triangular costal spot beyond this; from middle of dorsum an oblique curved streak which crosses the fold; along termen below apex the ochereous color forms a streak extending into the cilia at apex, where they are brown-tipped. Hind wings and cilia pale ochereous in female, sometimes grayish in male. Legs pale grayish ochereous. Abdomen whitish, shaded with gray in male.

Alar expanse 11 to 12 mm.

Male genitalia (figs. 85, 85a). Similar to genitalia of *albaciliella*, differing in the longer socii, slender almost cylindrical anellus, and shape of aedeagus. Scale sac more or less spherical.

Female genitalia (fig. 84). Sclerotized part of segment 8 clothed with long slender scales, a denser tuft of short and long hair-scales laterally, adjacent to a circular depressed hyaline spot; ostium in a broad cup-shaped depression, each lateral margin produced into a sharp free point; signum a narrow ring, spines short and abruptly sharp.

Specimens examined.—18 ♂, 7 ♀, 47 ♂, ♀.

CALIFORNIA: Mills College, Alameda County, ♂ type, 9 ♂, 3 ♀ paratypes, 19 paratypes, sex not determined, May 11, May 20 (G. R. Pilate) [A.F.B.Coll.]; 5 ♂, 2 ♀ paratypes, May 3 to May 11 (G. R. Pilate) [U.S.N.M.]; Colfax, Placer County, 2 ♂, 1 ♀, May 1, 1910 (A. H. Vachell) [U.S.N.M.]; Los Angeles County, 28 ♂, ♀, April [U.S.N.M.]; San Diego, 1 ♂, 4-14-07 (W. S. Wright), 1 ♀ [U.S.N.M.].

Food plant and early stages unknown.

In *B. ochristrigella*, the minute labial palpi, slender, downward projecting points, are easily discernible.

B. ochristrigella is separated from its nearest ally, *B. albaciliella*, by the creamy white color of the fore wings, and the ocherous streak extending along termen into the apical cilia. Genitalia of both sexes indicate the close relationship of the two species.

(19) ***Bucculatrix eurotiella*** Walsingham

(Figs. 88, 88a, 88b, 88c, 89, 89a, 90.)

1907. *Bucculatrix eurotiella* Walsingham, Proc. U. S. Nat. Mus. XXXIII: 221.

Type ♀, Lancaster, Los Angeles County, California [U.S.N.M., Type No. 10352].

1925. *Bucculatrix chrysothamni* Braun, Trans. Amer. Ent. Soc. LI: 219. Type ♂, Logan, Cache County, Utah [A.F.B.Coll.]. **New synonymy.**

Head and tuft white, antennal stalk white with gray or blackish annulations, nearly white near base. Thorax white, or sometimes faintly ocherous anteriorly. Fore wings white, marked with patches of ocherous and brown-tipped ocherous scales; a small such patch at basal third of costa (sometimes represented by a few scales only); a large patch of such scales beyond middle of costa sometimes extends as a pale ocherous shade across the wing there joining a similar patch of scales on dorsum nearer base, thus forming an inwardly oblique transverse band; the costal portion of this band may be connected by a line of scales with a patch of ocherous and brown-tipped scales of variable size and extent along the termen, which may project basad as an acute triangle; this patch continues to apex as a marginal row of dark-tipped scales and projects

into the cilia at apex; the inner edge of the dorsal patch bears, just below fold, a more or less conspicuous group of broadly brown or blackish-tipped scales; either the costal or dorsal patch of scales may be indistinct or lacking; a small patch of dark-tipped scales (sometimes absent) on costa near apex, a line of dark-tipped scales through middle of cilia along termen; cilia on costa near apex white, grayish toward tornus. Hind wings pale brownish gray, palest in females. Legs whitish, middle tibiae gray-striped, all tarsal segments gray-tipped. Abdomen pale grayish ochereous.

Alar expanse 8 to 10 mm.

Male genitalia (figs. 88, 88a, 88b, 88c). Harpe slender, almost cylindrical, but broadening basally, dense black setae on outer fourth; socii widely separated, about twice as long as broad, setae long; anellus sclerotized ventrally; aedeagus appearing as if jointed, apical portion slender, bent, arising from a depression in the broader basal portion; vinculum narrow. Scale sac (fig. 88c) tapering to small base.

Female genitalia (figs. 89, 89a, 90). Ovipositor lobes elongate; ostium opening into a deep furrow, its sclerotized sides curving outward; inception of ductus seminalis almost at ostium; beneath the produced lateral lobes of segment 7, a fan of specialized scales attached to the intersegmental membrane, the lobes of 7 margined with slender scales (fig. 90); lateral margins of segment 8 produced anteriorly into slender prongs (anterior apophyses); ductus bursae slender throughout; bursa copulatrix large, occupying segments 2 to 5; signum almost longitudinally placed, two broad lateral bands of spined ribs, joined anteriorly (ventrally) and posteriorly (dorsally) by a series of short ribs.

Specimens examined.—27 ♂, 17 ♀.

CALIFORNIA: Lancaster, Los Angeles County, ♀ type, "Larva from leaves of *Eurotia canata* [?= *lanata* (Pursh) Moq.]. Pupa in a white ribbed cocoon, issued May, 1880 (A. Koebele, collector)" [U.S.N.M.]; Mint Canyon, Los Angeles County, 1 ♂, "larva on *Senecio* sp., emdg. April 26, 1939" (J. A. Comstock) [U.S.N.M.]; Love Joy Buttes, Los Angeles County, 12 ♂, 7 ♀, "emdg. April 18, 1940" (Lloyd M. Martin) [Los Angeles County Museum].

UTAH: Cache County (near Logan), ♂ type of *chrysothamni*, 10 ♂, 9 ♀, paratypes of *chrysothamni*, June 25, 1924 (A. F. Braun) [A.F.B.Coll.]; 1 ♂, June 25, 1924 (A. F. Braun) [A.N.S.P.].

BRITISH COLUMBIA: Shingle Creek, Penticton, 1 ♂, June 25, 1935 (A. N. Gartrell) [C.N.Coll.]; Seton Lake, Lillooet, 1 ♂, June 13, 1926 (J. McDunnough) [C.N.Coll.].

The identification of the food plant of the type as *Eurotia canata* [? *lanata*], belonging to the Chenopodiaceae, is most certainly an error. Genitalia slides of females of the *Chrysothamnus*-feeding and *Senecio*-feeding specimens agree in all respects with a slide of the female (not male, as stated by Walsingham) type, by J. F. G. Clarke. Such a di-

versity of food plants (members of unrelated plant families) is unknown in the genus.

No details of larval habits are available. The white cocoon of this species is distinguished from the smooth cocoon of *B. seneciensis*, when the two species are reared together on the same food plant (*Senecio* sp.), by the eight distinct ridges.

Misled by the recorded food plant as *Eurotia*, specimens collected resting at the tips of the linear leaves of *Chrysothamnus graveolens* (Nutt.) Greene were described as *chrysothamni*.

The California series of specimens are more conspicuously and more clearly marked than the Utah specimens and agree more closely with the type.

The distinctive wing markings separate this species from all other described American species. Genitalia, especially of the female, indicate affinity with the following species, *B. tenebricosa* Braun. The aspect of the latter is however very different, and it will not be confused with *B. eurotiella* by superficial examination.

(20) ***Bucculatrix tenebricosa*** Braun (Figs. 91, 92.)

1925. *Bucculatrix tenebricosa* Braun, Trans. Amer. Ent. Soc. LI: 220. Type ♂, near Logan, Cache County, Utah [A.F.B.Coll.].

Head and tuft white; antennal stalk white with broad dark gray annulations. Thorax white. Fore wings white, with scattered pale brownish-tipped scales and clusters of dark brown-tipped scales, which form ill-defined markings; a cluster of a few of these scales before middle of costa, a larger such cluster beyond middle of costa, and a small patch of raised dark scales below fold; dark-tipped scales extend along the base of the costal cilia and around apex to tornus, forming at the apex a scattered patch; a line of black-tipped scales crosses the cilia opposite apex and continues as an irregular line to tornus. Hind wings silvery gray with white cilia. Legs white, tibiae and tarsi of the fore and middle legs broadly banded with gray, hind tarsal segments only banded with gray. Abdomen pale gray.

Alar expanse 7 mm.

Male genitalia (fig. 92). Harpes slender, tapering rapidly to the very narrow cylindrical apical third, heavy setae at apex; socii widely separated, elongate, three times as long as broad, very thin membranous, fine setose; anellus a tapering cone; aedeagus broad at base, tapering, appearing as if jointed, the outer portion slender and curved, arising from a depression in the broader basal portion; vinculum a broad band. Scale sac elongate pear-shaped.

Female genitalia (fig. 91). Ovipositor lobes short; ostium opening into a deep furrow, its sclerotized sides curving outward; produced lateral lobes of segment 7 with curved specialized scales; a cluster of scale sockets at anterior lateral margin of segment 8 indicates the probable presence of a tuft of specialized scales (lost on the slide); ductus bursae slender throughout; signum a transversely placed ring, signum ribs with long slender spines.

Specimens examined.—2 ♂, 1 ♀.

UTAH: near Logan, Cache County, ♂ type, 1 ♂, 1 ♀ paratype, June 25, 1924, flying amongst rabbit brush, *Chrysothamnus graveolens* (Nutt.) Greene, (A. F. Braun) [A.F.B.Coll.].

Known only from the three specimens of the type series. Food plant and early stages unknown.

By genitalia, *B. tenebricosa* is closely allied to *euotiella* Wlsm. In the male, it differs from *euotiella* by the very broad base of aedeagus, and the longer, slender socii; in the female, by the broad short ovipositor lobes, and especially by the very different signum, a transverse ring in *tenebricosa*, an elongate, longitudinally placed ellipse in *euotiella*. The moths are distinct in general appearance, although the ill-defined wing markings of *tenebricosa* are situated as in *euotiella*.

(21) ***Bucculatrix ericameriae*** new species (Figs. 93, 93a, 93b.)

Face and tuft white, eye-caps white, a few basal segments of antennal stalk entirely white, remainder of stalk conspicuously blackish-annulate. Fore wings white, with markings formed by brown-tipped ocherous scales; a line of such scales along costa from base diverges from costa just before middle forming a short slender oblique streak not attaining the middle of the wing; from two-thirds of costa, a broader oblique streak crosses the wing to tornus, the scales of its outer margin more broadly blackish-tipped; before apex, an irregular costal spot, its inner margin touching the outer margin of the oblique streak in the middle of the wing; on middle of dorsum, a large irregular spot, inwardly margined by a row of blackish scales, and bearing on fold a few raised scales; a short line of blackish-tipped scales opposite apex in the cilia, and a second line of such scales through the white cilia from apex to tornus. Hind wings and cilia fuscous. Legs whitish, tarsal segments conspicuously dark-tipped. Abdomen shaded with fuscous above, whitish beneath.

Alar expanse 8 mm.

Female genitalia (figs. 93, 93a, 93b). Ovipositor lobes setose, with minute setae amongst the larger setae; near posterior margin of segment 8, a pair of membranous lobes, clothed with remarkable flattened specialized setae lying nearly in a dorso-ventral plane; each seta consists of a thin plate broad at the tip, the margin of one side thickened (fig. 93a) so that when viewed from the ventral side they appear as slender curved hairs (fig. 93); ostium small, round,

opening into a broad elongate sinus, with widely flaring margins; groups of specialized scales on posterior margin of segment 7 (position indicated on the figure by scale sockets); signum ribs with long slender spines, and an occasional heavier spine (fig. 93b).

Type.—♀, Placerville, California, 5-1-16, on *Ericameria arborescens* (Gray) Greene, F. B. Herbert, Coll. [U.S.N.M., Type No. 65019].

Paratype.—♀, same data as the type.

Only the female is known.

Although this species displays a general type of markings common to many western species of the genus, the unusual female genitalia will serve to separate it from all other species of our fauna.

(22) ***Bucculatrix variabilis*** Braun (Figs. 94, 94a, 95, 95a.)

1910. *Bucculatrix variabilis* Braun, Ent. News XXI: 176. Type ♂, Mills College, Alameda County, California [A.F.B.Coll.].

Face grayish white, tuft with intermingled whitish, brown and fuscous hairs, eye-caps whitish, minutely fuscous-speckled, stalk narrowly dark-annulate. Thorax grayish, scales fuscous-tipped. Fore wings clothed with fuscous-tipped scales, their bases whitish, thus giving the wing an irrorated aspect; just before middle of wing a pair of oblique curved white streaks, meeting or nearly meeting above the fold; except for the dark inner margin of the costal streak, the ground color is paler basad of these streaks; at apical third of costa a nearly perpendicular white costal streak which meets in the middle of the wing the apices of a pair of streaks, the first from beyond middle of dorsum outwardly oblique and parallel to the first dorsal streak, the second from beyond tornus inwardly oblique; the median area of the wing between the white streaks much darkened, especially in its dorsal half, which bears on its inner margin a blackish patch of slightly raised scales; before apex a curved white costal streak, sometimes indistinct, which partially encloses the apex; an irregular black apical dot from which a line of dark-tipped scales extends along termen to the white streak; a curved line of dark-tipped scales in cilia around apex. Hind wings pale gray. Legs pale gray, tarsal segments dark-tipped. Abdomen silvery gray.

Alar expanse 7 to 8 mm.

Male genitalia (figs. 94, 94a). Harpe with heavy setae apically, setae progressively more slender proximad; socii widely separated at base, slender, elongate, curved, their apices directed toward each other; uncus present, a small sharp hook; anellus with two broad thickened lobes dorsally, otherwise thin membranous; aedeagus appearing as if segmented, the slender apical section arising in a depression of the broader basal section; vinculum a band. Scale sac present.

Female genitalia (figs. 95, 95a). Ostium in a deep cup-shaped chamber, nearly as deep as the length of the anterior half of segment 7, which overlays it; lateral posterior ventral margins of segment 7 produced as flat plates, densely clothed with minute scales and margined outwardly by regularly placed short comb-like scales (fig. 95a); signum a broad ring near posterior end of bursa copulatrix, signum ribs with evenly placed long spines.

Specimens examined.—8 ♂, 9 ♀.

CALIFORNIA: Mills College, Alameda County, ♂ type, rearing record B.226, on *Baccharis pilularis* DC., imago May 12, 1908 (G. R. Pilate) [A.F.B.Coll.], 2 ♀ paratypes, rearing record B.226, imagoes April 25, 1908 [A.F.B.Coll.], 1 ♂ paratype, March 25 (G. R. Pilate) [U.S.N.M., genitalia slide], 2 ♀ paratypes March 25 (G. R. Pilate) [A.F.B.Coll.]; 1 ♀, reared, imago April 23, accompanied by cocoons (W. D. Kearfott) [U.S.N.M., ♀ genitalia slide]; San Francisco, 1 ♀, reared on *Baccharis pilularis* (H. H. Keifer) [A.F.B.Coll.]; Berkeley, 1 ♀, on *Baccharis*, imago March 18, 1926 (W. W. Jones) [A.F.B.Coll.]; Stanford, Santa Clara County, 1 ♀, March 10 [U.S.N.M.], 5 ♂, 2 ♀, reared on *Baccharis*, imagoes from February 5 to April 15 (J. W. Tilden) [A.F.B.Coll.].

Food plant, *Baccharis pilularis* DC. In the original description of the species the food plant was incorrectly identified. Cocoon whitish, with six low ridges and a partial seventh ridge.

The name *variabilis* is hereby restricted to those specimens of the original series agreeing with the above description. The statement in the original description "sometimes the white color predominates" applies to the following closely related species, feeding on the same food plant at the same time.

Forbes in the Lepidoptera of New York and Neighboring States (1923) sunk *variabilis* as a synonym of *ainsliella* Murtf. The two species are in no way related, belonging to different sections of the genus, and there is no basis for the synonymy. McDunnough in the Checklist of Lepidoptera of Canada and the United States of America, Part II (1939) correctly lists the two species.

(23) ***Bucculatrix separabilis*** new species (Figs. 96, 96a, 97, 97a.)

1910. *Bucculatrix variabilis* Braun (in part), Ent. News XXI: 176.

Face and tuft white, the latter with brown hairs centrally; antennal stalk white with conspicuous black annulations. Thorax white, speckled with black-tipped ocherous scales. Fore wings white, marked with scattered black-tipped ocherous scales, and with groups of ocherous and black-tipped ocherous scales, which form rather well-defined markings; except for a line of black-tipped scales

along costa, the basal third of the wing above the fold is immaculate; scattered dark-tipped scales extend along the fold and above it toward middle of wing and dot the wing below fold in its basal half; an oblique streak of dark-tipped scales from basal third of costa, and a similar but broader streak from middle of costa, separated from one another by a narrow white streak; an ill-defined white streak beyond the second dark streak; on middle of dorsum a large patch of dark-tipped scales, with a few black raised scales on its inner edge; ocherous scales, often not dark-tipped, form a patch which may start as a longitudinal streak along the middle of the wing, curving downward and widening as it reaches dorsum before tornus, and bordered on termen by raised black-tipped scales; ocherous scales predominate in the apical area of the wing; a few black scales form an irregular apical spot; a line of black-tipped white scales through the cilia from apex along termen. Hind wings pale yellowish gray. Legs pale yellowish gray, tarsal segments black-tipped. Abdomen pale yellow gray, fuscous posteriorly, except anal segments whitish.

Alar expanse 8 to 8.2 mm.

Male genitalia (figs. 96, 96a). Similar to male genitalia of *B. variabilis*, but best distinguished by the short and broader erect socii; anellus without the thickened dorsal lobes. Scale sac present.

Female genitalia (figs. 97, 97a). Ostium in a cup-shaped chamber, similar to that of *B. variabilis*, but narrower and less than half its depth; lateral lobes of segment 7 rounded, clothed with short slender scales; signum as in *variabilis*.

Type.—♀, Stanford, Santa Clara County, California, reared on *Baccharis*, imago April 28, 1946 (J. W. Tilden) [A.F.B.Coll.].

Allotype.—♂, same data as the type, except date of emergence, April 27 [A.F.B.Coll.].

Paratypes.—1 ♂, 1 ♀, Stanford, California, reared on *Baccharis*, imagoes April 27 and 28, 1946; 2 ♂, Stanford University, reared on *Baccharis*, imagoes March 17 and 27 (J. W. Tilden) [A.F.B.Coll.]; 1 ♂, Stanford University, April 1, 1947 (J. W. Tilden) [U.S.N.M.]; 2 ♂, Half Moon Bay, California, on *Baccharis pilularis*, April 26, 1937 (W. H. Lange) [A.F.B.Coll.]; 1 ♀, Mills College, California, rearing record B.226, on *Baccharis pilularis* DC., imago May 12, 1908 (G. R. Pilate) [A.F.B.Coll.].

Bucculatrix separabilis and *B. variabilis* feed together on the same food plant (*Baccharis pilularis* DC.), and specimens of both species may be obtained in the same rearing. At the time of describing *variabilis* they were erroneously regarded as a single variable species. The two species are separated by wing markings which show little intra-specific variation, and no intergrading. The close genetic relationship of the two species is indicated by the genitalia, especially by the unique character of the female genitalia; they differ by qualitative characters

of both sexes. These two sympatric species, one of a number of paired (sibling) species occurring in this genus, are an outstanding example of speciation without isolation.

(24) **Bucculatrix brunnescens** new species (Figs. 99, 99a, 99b.)

Face whitish, tuft mingled white and brownish ocherous, eye-caps white, antennal stalk whitish ocherous, with somewhat darker ocherous annulations. Fore wings whitish (with slight ocherous tinge), dusted with scattered brownish ocherous scales; markings formed by groups of closely placed brown-tipped ocherous scales; at middle of wing a narrow oblique costal streak; beyond middle a more conspicuous streak, broad on costa and continued as a narrow line of scales to termen; apical area occupied by brown-tipped scales, with a few darker scales at extreme apex; at middle of dorsum, an irregular patch of brown-tipped scales, produced distally along fold; cilia pale fuscous. Hind wings pale grayish, faintly ocherous tinged, cilia concolorous. Legs whitish, segments dark-tipped.

Alar expanse 6.5 mm.

Male genitalia (figs. 99, 99a, 99b). Harpes broadly rounded at apex, with short conical setae; socii broadly triangular, setose; anal region minutely spinulose; anellus swollen before tip; vinculum asymmetric, the left lobe broader; aedeagus sinuate before apex, cornutus present, a slender decumbent curved tooth. Scale sac small, scales few.

Type.—♂, Elk Point, South Dakota, 1914 (C. N. Ainslie) [U.S.N.M., Type No. 65020].

Although nothing is known of the early stages of this species, the conical setae of harpe suggest a Composite feeder.

The characteristic genitalia and the brownish markings on a whitish ground color distinguish this species.

(25) **Bucculatrix evanescens** new species (Figs. 98, 98a, 103, 103a, 104.)

Face and head creamy white, tuft tinged with straw color centrally; eye-caps creamy white, antennal stalk annulate with pale gray. Thorax and fore wings creamy white. The fore wings may be almost immaculate, except for a faint yellowish shade along basal half of costa, a small black dot at end of cell and a few minute black specks in the cilia, or with faint longitudinal pale yellowish shading, sometimes a single black scale below basal fourth of fold, a few black scales at two-thirds of fold, a few scattered dark scales in the yellowish streaking, especially at outer third of costa, and two faint lines of scales in the cilia (all these markings present and most distinct in the type ♂, faint or absent in the allotype ♀, distinguishable in some of the paratypes). Hind wings and cilia creamy white, concolorous with the fore wings. Legs creamy white, sometimes outwardly shaded with pale gray, tarsal segments dark-tipped. Abdomen pale grayish straw-colored, with some darker shading.

Alar expanse 5.8 to 7 mm.

Male genitalia (figs. 98, 98a). Harpes club-shaped, apex with heavy widely spaced setae; tegumen long, socii very small, widely separated, only the small rounded apex setose; anellus a truncated cone; aedeagus cylindric, forked at apex, with opposing teeth; vinculum quadrate. Scale sac bilobed.

Female genitalia (figs. 103, 103a, 104). Ovipositor setose, membrane microscopically spinulose; sternite of segment 8 clothed with pigmented specialized scales, of which two groups of such specialized scales are most prominent, one of these attached to the intersegmental membrane at its posterior margin and lying lateral to ostium, the other attached along a longitudinal band near the lateral margin; other specialized scales, some long, some short and more or less trapezoidal are present along the lateral margins of the eighth sternite (fig. 104); ostium at anterior margin of 8, the furrow beyond with sclerotized branched margins, ending anteriorly in curved free points; inception of ductus seminalis on dorsal side of ostium; ductus bursae narrow in segment 7, at first abruptly and then gradually widening to bursa; signum open ventrally between its longest ribs, narrow and weak dorsally; signum ribs strongly sclerotized, spines few.

Type.—♂, Olancha, Inyo County, California, June 16–23 [U.S.N.M., Type No. 65021].

Allotype.—♀, same data as the type [U.S.N.M.].

Paratypes.—1 ♂, Olancha, Inyo County, California, June 16–23 [U.S.N.M.]; 1 ♂, Havilah, Kern County, California, June 1–7 [U.S.N.M.]; 3 ♀, Boyce Thompson Arboretum, Superior, Arizona, July 11, 12, 13, 1939 (A. F. Braun) [A.F.B.Coll.].

Food plant and early stages unknown.

The creamy white fore wings may aid in recognition of this species, but the unique genitalia, especially the remarkable scaling of segment 8 of the female will identify this species with certainty. The wing expanse of the three Arizona specimens measures a scant 5.8 mm.

(26) ***Bucculatrix benenotata*** new species

(Fig. 102.)

Face white, with gray shading; forward projecting section of the tuft gray, the gray color continuing as a streak along the middle of the eye-cap; the upright and backward projecting section of mingled gray and white hairs; antennal stalk whitish, with broad gray annulations. Thorax white, gray dusted; tegulae anteriorly dark gray. Basic color of the fore wing white, the white color somewhat obscured by gray-tipped scales; along costa from base a conspicuous brownish gray streak, becoming obsolete at the middle of the wing length; dorsad of this a wedge-shaped white area immaculate except for a sprinkling of conspicuous black scales; between the white wedge and the dorsum except for a white spot at the inner edge of a group of black scales on the fold, the wing is clothed with very small pale gray scales which are minutely dark

gray-tipped (a few black scales may dot this area); the outer half of the wing is more coarsely and unevenly dusted; a more or less defined group of dark-tipped scales near middle of dorsum includes the black scales on fold; this group of scales may be extended obliquely outward to costa; a small elongate black dot at end of cell; marginal scales at apex and along termen distinctly dark-tipped; a short row of dark-tipped scales around apex in the cilia. Hind wings and cilia pale silvery gray. Fore and middle tibiae dark gray, posterior tibiae silvery gray, all tarsal segments dark gray-tipped. Abdomen dark leaden gray.

Alar expanse 8 mm.

Female genitalia (fig. 102). Ovipositor lobes setose, membrane microscopically spinulose; segment 8 clothed with groups of pigmented specialized scales; a pair of arcs of very dark-pigmented small scales curves outward and posteriorly from near the mid-anterior ventral margin of segment 8, forming the most conspicuous structure of the segment; groups of elongate scales within and attached posterior to the arcs; near posterior lateral margins of sternite, spreading clusters of scales directed toward mid-line; near anterior margin of tergite of 8, a patch of minute specialized scales partially visible between the groups of scales on sternite; ostium at the anterior margin of 8, the furrow beyond it with sclerotized branched margins, ending anteriorly in curved free points; inception of ductus seminalis on dorsal side of ostium; signum narrow, open dorsally for a wide space, spines few.

Type.—♀, Pena Blanca Canyon, Santa Cruz County, Arizona, 26 August, 1959 (R. W. Hodges) [Cornell U., Type No. 3642].

Allotype.—♂, same data as the type, except date August 11, (R. W. Hodges) [Cornell U., Type No. 3642]. (Received too late to include description and figure of male genitalia.)

Paratypes.—1 ♀, same data as the type, 2 ♀, same data as the allotype (R. W. Hodges) [Cornell U.].

Food plant and early stages unknown.

The female genitalia indicate the close relationship of *B. benenotata* new species and *B. evanescens* new species. The dark-pigmented arcs on segment 8 of the female characterize *B. benenotata*. The contrast in coloration of the wings of the two species would not immediately suggest this relationship; however they agree in the presence of a stripe along costa from base, and a black dot at end of cell.

(27) ***Bucculatrix floccosa*** Braun (Figs. 100, 100a, 100b, 101, 101a, 101b.)
1923. *Bucculatrix floccosa* Braun, Trans. Amer. Ent. Soc. XLIX: 124. Type ♀, Olancha, Inyo County, California [A.F.B.Coll.].

Face white, tuft white, some brownish hairs centrally; eye-caps white, a few basal segments of the antennal stalk white with very faint and narrow ochereous

annulations, remaining segments white at base, each segment shading through ochreous to dark brown, tips of antennae darker. Fore wings white, marked with patches of pale yellow brown-tipped scales; a few such scales just within the costa near base, sometimes forming a line reaching to one-third the wing length and there meeting an oblique streak or patch extending about one-third across the wing; beyond middle of costa a second and larger oblique streak ending in the middle of the wing in a group of black-tipped scales; before apex on costa, a more or less triangular patch of brown-tipped scales; in the middle of the wing at about basal fourth, a patch of brown-tipped scales, irregular and sometimes diffuse and indistinct; on middle of dorsum, a large patch of brown-tipped scales, attaining the middle of the wing, a few of the scales on its inner margin black-tipped and raised; brown-tipped scales at apex, a few of these sometimes black-tipped, and along termen forming at tornus a somewhat noticeable patch; scales, black-tipped opposite apex, sometimes continue through the white cilia to tornus as a faint line. Hind wings yellow white. Legs white, tarsal segments black-tipped. Abdomen whitish.

Alar expanse 8 to 8.8 mm.

Male genitalia (figs. 100, 100a, 100b). Harpe with small apical lobe (cucullus) clothed with heavy conical setae; tegumen long with basal strong sclerotization, its lateral prongs free at tips; socii setose, small, short, rounded; uncus present, a sharp curved hook; anellus broad at base tapering to oblique aperture; aedeagus large, more than half the length of the body, basal half wide, thence abruptly and irregularly narrowing to the slender curved apex; vinculum narrow, with strongly sclerotized median band. Scale sac present, small.

Female genitalia (figs. 101, 101a, 101b). Surface of ovipositor lobes microscopically tuberculate between setae; on each side of ostium on segment 8, a large patch (nearly half the width of the sternite) of minute specialized scales with strongly sclerotized margin toward mid-ventral line and at its anterior end (fig. 101a); ostium rounded, ductus bursae contracted immediately before ostium, but almost at once expanding nearly to the diameter of the bursa, contracting slightly before entering bursa copulatrix; signum a narrow ring, open mid-ventrally, indistinct dorsally, signum ribs (fig. 101b) short, with a few long spines, some of dorsal ribs with a single spine.

Specimens examined.—6 ♂, 4 ♀.

CALIFORNIA: Olancho, Inyo County, ♀ type, May 11, 1917 (G. R. Pilate) [A.F.B.Coll.], 3 ♀ paratypes, May 19, 22, June 16, 1917, 1 ♂ paratype, May 22, 1917 [A.F.B.Coll.]; 1 ♂, Monache Meadows, 8000', Tulare County, July 17, 1917; 1 ♂, Palm Springs, March 28, 1917; 1 ♂, Loma Linda, June 5, 1912 (G. R. Pilate) [A.F.B.Coll.].

NEVADA: Pyramid Lake, 2 ♂ [U.S.N.M.].

In the Palm Springs specimen (determined as this species by genitalia slide) most of the scales of the markings are blackish tipped, and less scattered, producing a general grayish aspect.

The characteristic genitalia of both sexes serve to identify this species; in the male, the long irregular aedeagus, small socii and apical lobe of harpe; in the female, the scale patches on segment 8, of a character present in no other species.

(28) **Bucculatrix flourensiae** new species (Figs. 105, 105a, 105b, 106, 107.)

Face and head, including eye-caps and tuft silvery white, the latter with a central line of brown hairs; antennal stalk gray, with paler annulations. Thorax white, sometimes with minute grayish ochereous speckling. Head and thorax conspicuously contrasting with the dark wings. Basic ground color of the fore wings grayish white, with faint ochereous tinge, but with most of the scales shading through ochereous to blackish brown at their tips, so that the prevailing color is a speckled rather dark grayish brown, with merely a few streaks and spots of the basic ground color visible; such spots and streaks are delimited by scales darker-tipped than those making up the prevailing color; before middle of costa a pale oblique streak curving to middle of wing, and followed by a streak of dark scales of equal width; beyond this a second similar pale streak, its inner edge parallel to the first, diffuses toward apex as a triangular area, but except in its proximal narrow oblique portion, is marked transversely by narrow blackish lines; at middle of dorsum a short narrow nearly perpendicular pale patch, and before tornus, a similar but oblique pale patch enclose between them a more or less defined patch of the dark scales; apex whitish, with transverse short lines of dark-tipped scales on either side and at extreme tip; two lines of closely parallel dark scales curving around apex and extending through the grayish cilia toward tornus. Hind wings pale fuscous, cilia ochereous tinged at bases. Basal segments of legs whitish, middle tibiae barred with fuscous, hairs of hind tibiae whitish, tarsal segments pale gray, black-tipped. Abdomen grayish white, posterior margins of segments darker.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 105, 105a, 105b). Harpes broad, parallel-sided, apical third setose, the setae around the curved apex conical; socii diverging, large and broadening toward tip, setose on the outer half of apical area only; uncus well-developed, elongate tongue-shaped, densely setose; anellus conical, sclerotized laterally at base; aedeagus a slender cylinder, aperture elongate, vinculum broadly triangular. Scale sac present, scales minute.

Female genitalia (figs. 106, 107). Basal area of segment 8 highly specialized both ventrally and dorsally; ventrally a broad sclerotized band with lateral lobes margined with long specialized scales; dorsally, a sclerotized band, its ends somewhat enlarged and margined with long slender specialized scales (fig. 107); ductus bursae sclerotized in segment 7, ostium near anterior margin of segment 8, with the sclerotized band projecting slightly over it; signum elongate, longitudinally placed, ribs strongly sclerotized, the ventral with a single row of strong spines (*v*), the dorsal short and bilaterally spined (*d*).

Type.—♀, Pearce, Arizona, September 5, 1957, with cocoon and fragment of leaf of *Flourensia cernua* DC. (W. W. Jones) [U.S.N.M., Type No. 65022].

Allotype.—♂, same data as the type [U.S.N.M.].

Paratypes.—1 ♂, 14 ♀, same data as the type, some with cocoon and fragment of leaf of *Flourensia cernua* DC., and bearing the additional notation "larvae defol. sq. mis. of *Flourensia cernua*" [Paratypes in U.S.N.M. and Univ. of Ariz.].

Fragments of leaves accompanying some of the specimens indicate that the entire leaf, except the upper epidermis and the network of veins is consumed. The *pale green* cocoon is spun on the underside of the leaf; it is marked with eight to ten prominent ridges.

The white head and thorax, contrasting with the dark fore wings should enable easy recognition of this species; the green color of the cocoon is unique. The specialized characters of segment 8 of the female separate this species from all others of our fauna.

(29) ***Bucculatrix franseriae*** new species

(Figs. 108, 109.)

Face grayish white, tuft composed of intermingled white and gray hairs; eye-caps whitish, minutely speckled with very pale gray, antennal stalk pale gray, with dark gray annulations. Ground color of the fore wings whitish, the scales minutely tipped with very pale gray, the markings formed by scales, some of which are very narrowly black-tipped, others broadly black-tipped; a narrow stripe of indistinctly dark-tipped scales along costa from base diverges from costa at one-third, forming a short oblique streak; just beyond middle of costa, a broader patch of narrowly black-tipped scales narrows abruptly below costa, and curves into the disc almost at tornus, thence curves upward to apex, thus forming a shallow arc along which the scales are conspicuously black-tipped; this arc encloses toward costa a whitish area, marked on costa by a patch of minutely dark gray-tipped scales; a few black-tipped scales in fold; on middle of dorsum, a large patch of minutely black-tipped scales, with a few more conspicuously black-tipped scales on its inner edge; cilia gray, with a line of black-tipped scales through the center. Hind wings and cilia pale grayish white. Legs grayish white, shaded with gray, tarsal segments, except those of the meta-thoracic legs, dark gray-tipped.

Alar expanse 8 mm.

Male genitalia (fig. 108). Harpe divided for about half its length, a broad thin concave outer lobe, and a slender strongly sclerotized inner lobe (a development of costa and cucullus), with heavy setae apically; socii, widely diverging arms with strong setae; anellus broad, strongly sclerotized, with a minute ventral apical process; aedeagus long, sinuate, curved toward apex, aperture prolonged basad as a narrow slit with a broad overlapping triangular flap at its base; vinculum prolonged anteriorly into long lateral prongs. Scale sac very large, scales club-shaped.

Female genitalia (fig. 109). Ovipositor lobes with two kinds of setae, short minute setae posteriorly, longer and more scattered setae anteriorly; segment 8 highly specialized, its lateral margins produced as elongate wings finely reticulate posteriorly, each bearing near its anterior end, a cluster of specialized scales; anterior margin of segment 8, lateral to ostium, strongly sclerotized and highly specialized (see figure); the strongly sclerotized posterior section of ductus bursae bending to the right, from the anterior end of this strongly sclerotized section the ductus curves posteriorly, then anteriorly to the bursa copulatrix; signum composed of clusters of closely placed parallel spined ribs, spines slender.

Type.—♂, Tempe, Arizona, 13 Feb. '55, reared from *Franseria deltoidea* Torr., (F. F. Bibby) [U.S.N.M., Type No. 65023].

Allotype.—♀, same data as the type. Genitalia figured from allotype [U.S.N.M.].

Paratypes.—2 ♂, 1 ♀, same data as the type. Male genitalia figured from a paratype [U.S.N.M.].

The recorded food plant is *Franseria deltoidea* Torr. Cocoon gray, somewhat mottled, with seven or eight fine ridges.

None of the specimens is in perfect condition; most would be unrecognizable except by genitalia, but the extraordinary genitalia of both sexes warrant the description of the species. The male type is in the best condition, with abdomen and appendages present; the female allotype is worn; the paratypes lack one or more wings, head, or abdomen.

(30) **Bucculatrix staintonella** Chambers

(Figs. 110, 110a, 110b, 110c, 111.)

1878. *Bucculatrix staintonella* Chambers, Bull. U. S. Geol. and Geogr. Surv. of Terr. IV: 133. Cotype ♂ (one of three cotypes, this one only in good condition) here designated Lectotype, and bearing the following labels: (1) Red and white with "Type" at top on white and "1310" on bottom red portion, (2) White label with "Chambers. Color." (3) White label with "*Bucculatrix albella*, Cham. Coll." (4) ♂ genitalia 29.X.1957 JFGC No. 10654.

Edgerton, Colorado, altitude 6000 feet [M.C.Z., Type No. 1310].

1877. *Bucculatrix albella* Chambers (not Stainton), Bull. U. S. Geol. and Geogr. Surv. of Terr. III: 141.

1918. *Bucculatrix pertenuis* Braun, Ent. News XXIX: 249. Type ♂ (one of the original type series), Winnfield, Louisiana [A.F.B.Coll.]. (**New synonymy.**)

Face and head white, tuft typically white, but usually with ocherous or brown hairs centrally; eye-caps white, antennal stalk pale ocherous gray, antennal notch of male very slight. Thorax white, and except in immaculate specimens, a pale ocherous median stripe. In markings of fore wings the most variable of our species; wings varying from pure white, with merely a few brownish or black-tipped scales in apex and in cilia of termen (type of *staintonella*), to creamy white with more or less well-defined oblique and longitudinal ocherous streaks, a more or less distinct line of blackish scales extending from just within the margin of termen to apex of wing, and a small, but often conspicuous dot of black raised scales beyond middle of fold (as described for *pertenuis*), and finally (in one specimen from Elk Point, South Dakota) wings suffused with pale reddish ocherous, longitudinal and oblique markings nearly obliterated, and only the dark scales toward apex and a ciliary line of blackish-tipped scales defined. When distinct, the markings are as follows: extreme costal margin near base blackish or dark brown, just within the costal margin a line of pale ocherous scales which meets before the middle of costa a very oblique narrow ocherous or dark-dusted streak, which before reaching middle of wing bends and runs parallel to costa, its apex meeting a second, less oblique and broader costal streak, its scales dark-tipped, which may cross the wing; a small group of black raised scales, attached just basad of the marginal row of scales on termen; these continue as a black line to apex of wing; on costa beyond the second oblique streak, a more or less defined triangular patch of ocherous or fuscous-tipped scales; an ocherous streak along the fold; a rather broad ocherous streak or spot beyond middle of dorsum, on its inner edge on fold a few black raised scales, usually forming a small black dot (absent in immaculate specimens); the ocherous scales may be lacking and then the black dot only is present; at tornus, an elongate group of dark-tipped scales; dark-tipped scales, sometimes scattered, form a line in the cilia of termen. Hind wings and cilia usually pale grayish, rarely ferruginous ocherous. Legs whitish, tarsal segments tipped with dark brown, minutely so in nearly immaculate specimens. Abdomen beneath whitish, above with more or less fuscous shading.

Alar expanse 6.5 to 9 mm.

Male genitalia (figs. 110, 110a, 110b, 110c). Harpe with a triangular flat apical area densely clothed with heavy black setae, the distal rows hooked, the setae progressively longer and more slender proximad, finally hair-like (fig. 110a); socii elongate, setose; anellus a cone, sclerotized ventrally; vinculum quadrate, produced anteriorly into a long slender rod; aedeagus slender except at base, sinuous. Scale sac bilobed (fig. 110c).

Female genitalia (fig. 111). Near anterior margin of segment 8 and lateral to ostium a pair of internal curved sclerotized processes; ostium with minute sclerotized points; extending laterally from either side of ostium a transverse sclerotized band; laterally near posterior margin of segment 7, a cluster of short,

specialized but striated scales; ductus bursae slender, widening near bursa, signum a narrow collar of spined ribs at the posterior end of bursa, spines long and slender.

Specimens examined.—21 ♂, 12 ♀.

COLORADO: Edgerton, ♂ type (V. T. Chambers) [M.C.Z.].

NEW MEXICO: Pecos, 1 ♂, at light, June 25 (Ckll.) [U.S.N.M.]; Las Vegas, 1 ♀, 7-8 (H. S. Barber, Collector) [U.S.N.M.]; State College, Dona Ana Co., 1 ♀, July 8, 1945 (J. R. Eyer) [J. R. Eyer Coll.].

LOUISIANA: Winnfield, 1 ♂ (type of *pertenuis* Braun), June 30, 1915 (G. R. Pilate) [A.F.B.Coll.]; 6 ♂, 3 ♀ (paratypes of *pertenuis* Braun), June 27 to July 9 (G. R. Pilate) [A.F.B.Coll.].

FLORIDA: Siesta Key, Sarasota County, 4 ♂, March 2 to April 17 (C. P. Kimball) [C. P. Kimball Coll.].

MISSOURI: Branson, Taney County, 1 ♀, July 9, 1938 (A. F. Braun) [A.F.B. Coll.].

IOWA: Sioux City, 8 ♂, 4 ♀, July (C. N. Ainslie) [U.S.N.M.].

SOUTH DAKOTA: Elk Point, 2 ♀ (C. N. Ainslie) [U.S.N.M.].

Food plant and early stages unknown.

The Pecos, New Mexico specimen was compared with the type at the Museum of Comparative Zoology by Dr. J. F. Gates Clarke, who writes "Your specimen has more of the black atoms apically than are present on the type and more of the faint, pale yellow streaks of the fore wing." Male genitalia of this specimen agree exactly with the type (slide of type by J. F. Gates Clarke), as do also the male genitalia of the Iowa and Louisiana specimens; the male genitalia of the Florida specimens, although agreeing structurally with the unique and characteristic typical genitalia, differ in the relatively short tegumen and very small socii.

The wings of the Iowa series show a gradation from well-defined and distinct markings as described to nearly immaculate. The great variation in wing markings thus renders identification except by genitalia uncertain. The characteristic and unique genitalia of both sexes separate *staintonella* from all other described species.

(31) ***Bucculatrix immaculatella*** Chambers

1875. *Bucculatrix immaculatella* Chambers, Canad. Ent. VII: 54. Type locality, Texas (? Bosque County).

1877. *Bucculatrix immaculatella* Chambers, Bull. U. S. Geol. and Geogr. Surv. of Terr. III: 141.

The type of *B. immaculatella* could be found neither in the Museum of Comparative Zoology nor in the United States National Museum. Chambers thus briefly characterized the species: "No tongue? Silvery white, immaculate. *Al. ex.* $\frac{5}{16}$ inch. Season, May." Again in describing *B. albella* Chambers (not Stainton), he writes: "Also resembles *B. immaculatella*, Cham. from Texas, but is smaller, and *immaculatella* has no dusting on the wings."

It is possible that *B. immaculatella* is an immaculate form of *B. staintonella*, and if so, the name *immaculatella* would have priority; however for the present, it had best be regarded as an unrecognized species.

(32) ***Bucculatrix agnella*** Clemens

(Figs. 112, 112a, 112b, 113, 113a, 113b, 113c, 113d.)

1860. *Bucculatrix agnella* Clemens, Proc. Acad. Nat. Sci. Phila.: 211. Type ♂, Easton, Pennsylvania [A.N.S.P., Type No. 7499].

1872. *Bucculatrix agnella* Stainton, Tin. No. Am., p. 147.

1903. *Bucculatrix agnella* Busck, Proc. Ent. Soc. Wash. V: 205.

1923. *Bucculatrix agnella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 157.

1873. *Bucculatrix capitealbella* Chambers, Canad. Ent. V: 150. Type, Kentucky [M.C.Z.]; two "Types" both without abdomen [U.S.N.M.].
(**New synonymy.**)

1878. *Bucculatrix capitalebella* Chambers, Bull. Geol. and Geogr. Surv. of Terr. IV: 133. (Spelling correction.)

1923. *Bucculatrix capitealbella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 157.

1875. *Bucculatrix albicapitella* Chambers, Canad. Ent. VII: 125. (**New synonymy.**)

1923. *Bucculatrix albicapitella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 157.

1923. "B. species C" Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 157.

Face white, somewhat shaded with pale brown; tuft white, in darker specimens with a considerable mixture of dark fuscous hairs; eye-caps white, antennal stalk dark fuscous, with narrow pale annulations. Thorax white, tegulae narrowly fuscous anteriorly. Fore wings white, with a variable degree of dusting with pale luteous scales, especially along the fold and toward dorsum, and in the apical area of wing; markings formed by oblique streaks of blackish- or fuscous-tipped scales, these streaks variable in extent and in depth of coloration; one such streak, often short, from basal third of costa is produced basad along costa to base; a second streak, just beyond middle of costa is darkest near costa and usually prolonged as a narrow luteous streak to middle of termen, there meeting a few black-tipped scales; these streaks are narrowly separated by the white ground color and the second is followed by a narrow white streak reaching across the wing nearly to termen; before apex a triangular patch of luteous

scales, broad on costa where the scales are usually fuscous-tipped; black scales form a more or less clearly defined apical spot, from which a few dark-tipped scales may project into the base of the cilia; a line of dark-tipped scales extends through the middle of the whitish cilia, fading out toward tornus; on the middle of the fold an irregular patch of a few black or fuscous-tipped scales is to a greater or less degree preceded and followed by the luteous scales; in the darker specimens, there are a few dark-tipped scales on dorsal margin near base. Hind wings and cilia whitish, the latter with a faint coppery tinge. Legs pale grayish luteous, tarsal segments conspicuously blackish fuscous-tipped. Abdomen pale gray, more or less shaded above with fuscous.

Alar expanse 7 mm.

Male genitalia (figs. 113, 113a, 113b, 113c, 113d). Harpe (113a) short and broad, nearly parallel-sided, weakly emarginate at apex, costal apical area clothed with strong setae; socii (113, 113b) exceeding the harpes, rounded, setose; subscaphium finely setose; anellus broad at base soon contracting and becoming parallel-sided; vinculum somewhat produced anteriorly; aedeagus (113c) tapering, aperture armed with sclerotized teeth. Scale sac (113d) bilobed, scales slender.

Female genitalia (figs. 112, 112a, 112b). Vaginal setae apparent, ostium at anterior margin of segment 8, ductus bursae strongly sclerotized in segment 7, inception of ductus seminalis at anterior margin of the sclerotized section; ductus bursae forked in segment 6, the forks entering bursa separately in segment 5; signum a ring ventrally broad, narrowing dorsad, and finally scarcely more than a series of dots; signum ribs (112a) with short branched spines.

Specimens examined.—38 ♂, 23 ♀, 14 sex not determined.

PENNSYLVANIA: Easton, ♂ type [A.N.S.P.]; Philadelphia, 1 ♂, May 13 (F. Haimbach) [A.N.S.P.]; Floradale, Adams Co., 1 ♂, July, 1917 [J. R. Eyer Coll.].

NEW JERSEY: New Lisbon, 4 ♂, 1 ♀, July 13, July 27, August 4, August 12, Sept. 21 (Darlington Coll.) [A.N.S.P.]; Montclair, 3 ♂, 5 ♀, Sept. 1, 5, 15; Essex County Park, 2 ♂, 2 ♀, May 15, 18, August 13, 23 (W. D. Kearfott) [U.S.N.M.]; 1 ♂, July 10 (W. D. Kearfott) [A.F.B.Coll.].

NEW YORK: Monroe County, 1 ♂, Aug. 1, 1949 (C. P. Kimball) [A. E. Brower Coll.]; 1 ♀, August 28, 1949 (C. P. Kimball) [C. P. Kimball Coll.].

MASSACHUSETTS: Barnstable, 1 ♂, July 6, 1950 (C. P. Kimball) [C. P. Kimball Coll.].

DISTRICT OF COLUMBIA: Washington, 6 ♂, 2 ♀, April 27, May 20, June, August (August Busck) [U.S.N.M.].

TENNESSEE: Nashville, 10 ♂, ♀, Sept., Oct. (G. G. Ainslie) [U.S.N.M.]; Monteagle, el. 2000, 1 ♂, Aug. 30 (A. G. Richards) [Cornell U.].

KENTUCKY: Type (*capitealbella* Chambers) [M.C.Z.]; 2 "types" (*capitealbella* Chambers) [U.S.N.M.]; 1 ♀ (labeled *capitibella* in Chambers' handwriting) [U.S.N.M.]; 1 ♂, 2 ♀, (August Busck) [U.S.N.M.].

OHIO: Cincinnati, 4 ♂, 4 ♀, April 24, May 26, Aug. 15-16, Sept. 4-12; Brown County, 1 ♂, 2 ♀, rearing record B.2212, larvae August 31, on leaves of *Ambrosia artemisiifolia* L., imagoes April 12, April 16; Mineral Springs, Adams County, 4 ♂, 1 ♀, Aug. 12-24; Pike County, 1 ♀, July 27 (A. F. Braun) [A.F.B.Coll.].

MICHIGAN: Wayne County, 4 ♂, August 16, September 12 (Ralph Beebe) [Ralph Beebe and A.F.B.Coll.].

TEXAS: 1 specimen without head, sex undetermined, labeled *capitcalbella* in Chambers' handwriting [U.S.N.M.]; may be *kimballi* and not *agnella*.

MISSOURI: "C, Mo. 8/12, 90, on apple" [U.S.N.M.]; 1 ♂ (Kirkwood), "Bucculatrix on Ambrosia, 1. 10/29 and 12/14" with typical pink cocoon [Cornell U.].

SOUTH DAKOTA: Elk Point, 1 ♂ (C. N. Ainslie) [U.S.N.M.].

The food plant of this widely distributed species is *Ambrosia artemisiifolia* L. and probably other species of the genus. The egg is deposited on the upper side of the leaf against a vein; except in the earliest part of its course, the long, very fine mine follows the extreme margin of the leaf for several of its divisions, sometimes towards its end turning inward onto the leaf blade. The mine is inconspicuous, the deserted mines scarcely visible when the epidermis shrivels at the leaf margin. The first white moulting cocoon is spun immediately on leaving the mine, the second is of denser texture than the first. The exposed larva at first skeletonizes the leaf, later consumes the entire leaf substance in irregular patches. Last instar larva dark reddish brown, with only the minute tubercles on which the setae are inserted, green. Cocoon slender, with six or seven ridges, of a dirty pinkish color, in contrast to the white cocoon of *B. ambrosiaefoliella* Chambers feeding on the same plant.

The specimens referred to by Forbes (Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 157) as "B. species C," "Larva on *Ambrosia*" are dark-marked specimens of *B. agnella*. The name "*albicapitella*" is an apparent transposition of syllables; it is not listed in Chambers' "Index."

B. agnella is closely allied to the following species from Florida and Texas, and is scarcely distinguishable from it except by characters of the female genitalia.

(33) **Bucculatrix kimballi** new species (Figs. 114, 114a, 114b, 115, 115a.)

Face white, tuft white; eye-caps and a few basal segments of stalk white, especially in female, stalk outwardly pale brownish gray, with faint paler annulations. Fore wings white, markings formed by fuscous or blackish-tipped scales; sometimes a faint longitudinal streak of luteous, sometimes minutely fuscous-tipped scales from base above fold to one-third the wing length, this streak sometimes wholly absent; a short oblique dark streak from one-third of costa is produced basad along costa to base; a second oblique streak, broad on costa, narrows below costa and extends as a narrow line to below middle of wing thence curving upward toward apex; toward costa this curved dark streak encloses a similarly curved white streak (sometimes obscured in the middle of the wing), which in turn encloses on costa a more or less triangular patch of luteous scales; on middle of dorsum a semicircular patch of dark scales, bordered with black raised scales; a minute black apical spot, and a row of black-tipped scales curving around apex in the cilia. Hind wings and cilia whitish ochereous, faintly fuscous-tinged in male. Legs whitish, tarsal segments dark-tipped, cilia of hind tibiae whitish. Abdomen white, shaded with fuscous above.

Alar expanse 7 mm.

Male genitalia (figs. 114, 114a, 114b). Harpe short, broad, apical margin indistinctly concave, costal apical area clothed with strong setae; socii small, apex truncate, setose; subscaphium finely setose; anellus a tapering cone, aperture dorsally with a minute sclerotized beak; vinculum produced anteriorly into a rounded V; aedeagus elongate, scarcely tapering, but widening slightly toward apex (in paratype, Levers, Texas, a few minute curved teeth visible near aperture). Scale sac very large, equalling the width of segment 2, bilobed (as in *agnella*).

Female genitalia (figs. 115, 115a). Posterior portion of ductus bursae in segment 7 greatly enlarged and strongly sclerotized; from the anterior end of this sclerotized section the ductus makes a nearly circular curve in segment 7, curving dorsad of the wide sclerotized section thence passing anteriorly to the bursa copulatrix which it enters in segment 5, this section of the ductus minutely dentate; signum, faint lines of slender spines (fig. 115a).

Type.—♂, Oneco, Manatee County, Florida, May, 1954 (Paula Dillman) [A.N.S.P., Type No. 7814].

Allotype.—♀, Siesta Key, Sarasota County, Florida, April 8, 1953 (C. P. Kimball) [A.N.S.P., Type No. 7814].

Paratypes.—2 ♂, Oneco, Manatee County, Florida, May 5, 1953 (Paula Dillman), 2 ♀, Oneco, Manatee County, Florida, May 5; 8, 1953 (Paula Dillman); 1 ♀, Gulf Coast Exp. Sta., Bradenton, Florida, September 30, 1955 (E. G. Keisheimer) [C. P. Kimball Coll.]; 1 ♂, Levers, Texas, June 21, 1917 [Cornell U.].

Food plant and early stages unknown; however, the species is probably a Composite feeder, and larvae should be sought in late spring and again in summer and late fall, as the dates of capture indicate at least two generations a year.

B. kimballi is closely allied to *B. agnella* Clemens, from which it is with difficulty distinguished by wing markings; the only apparent difference is the shape of the second dark costal streak, recurving toward apex. The very similar male genitalia further substantiate the close relationship to *B. agnella*; by female genitalia it is however clearly distinct from that species. The paratype from Levers, Texas is much worn; male genitalia substantiate the identity.

Bucculatrix kimballi is named in honor of Mr. Charles P. Kimball, from whom I received the Florida specimens of the type series.

(34) ***Bucculatrix ivella*** Busck (Figs. 116, 117, 117a.)

1900. *Bucculatrix ivella* Busck, Proc. U.S.N.M. XXIII: 243. Type ♂, Palm Beach, Florida [U.S.N.M., Type No. 4953].

Face white, in darker specimens the scales minutely brown-tipped; tuft white, brown centrally; eye-caps white, speckled with pale brown, antennal stalk pale luteous with narrow silvery annulations. Thorax whitish, scales, especially of the tegulae, brown-tipped. Fore wings overlaid with reddish brown, fuscous-tipped and fuscous scales, so densely in the darker specimens as to obscure the whitish ground color; from before middle of costa, a narrow very oblique brownish fuscous streak, sometimes faint or obsolete in pale specimens, is narrowly separated from a second more conspicuous very oblique costal streak, which in the middle of the wing becomes longitudinal, its apex directed toward a group of black raised scales on middle of termen, which continue to apex as a line of black scales; this costal streak is separated from a broadly triangular costal area by a narrow whitish streak which curves above the raised scales on termen; from base of wing, parallel to and above fold a narrow straight white streak, distinct in darker specimens, extends for more than half the wing length; along fold from base a broader stripe of fuscous-tipped scales; on dorsal margin near base a few blackish scales; beyond middle of dorsum, an oblique curved brown or fuscous spot, bearing on its inner edge a patch of black raised scales, is indistinctly and irregularly margined with the whitish scales of the ground color; a curved line of black-tipped scales through the cilia from costa to tornus. Hind wings and cilia pale gray, the cilia with a faint reddish tinge. Legs pale straw-colored, tarsal segments white, narrowly tipped with black. Abdomen whitish below, shaded with fuscous above.

Alar expanse 6.5 to 7.5 mm.

Male genitalia (fig. 116). Cucullus of harpe with heavy short modified setae; socii rounded, widely separated, setose; on margin of tegumen below each socius, a sharp curved hook; anellus conical; aedeagus broad at base, tapering to the slender tip; vinculum rounded anteriorly, a quadrate projection posteriorly. Scale sac small.

Female genitalia (figs. 117, 117a). A circular hyaline depression near lateral margin of segment 8; near posterior lateral margin a low rounded lobe bearing a tuft of slender scales; margin of ostium with diverging sclerotized points; ductus bursae sclerotized in posterior half of segment 7, thence very narrow and entering bursa near posterior margin of 6; signum elongate, nearly longitudinally placed, its halves appearing as two parallel bands on the elongate bursa; signum ribs irregularly spined, at intervals a rib with very large and strongly sclerotized teeth (fig. 117a).

Specimens examined.—78, ♂, ♀.

FLORIDA: Palm Beach, ♂ type, 4 ♂, 4 ♀ cotypes, reared on *Iva frutescens* L., imagoes February 23 to March 7, 1900 (H. G. Dyar) [U.S.N.M.]; Siesta Key, Sarasota County, 1 ♂, 2 ♀, April 5, March 31, 1952, April 11, 1953 (C. P. Kimball) [C. P. Kimball Coll.].

MARYLAND: "N. Riv. Hwy 50," 45, ♂, ♀, larvae and cocoons on *Baccharis halimifolia* L., July 26, imagoes August 1–11, 1941; cocoons and mined leaves accompanying the series (J. F. G. Clarke) [U.S.N.M.].

NEW JERSEY: New Lisbon, 9 ♂, 8 ♀, emerging from cocoons collected on leaves of *Baccharis halimifolia* L., and on surrounding salt meadow grass, July 20–24 (E. P. Darlington) [A.N.S.P.]; 2 ♂, 1 ♀, same data [A. E. Brower Coll.]; 5 M. Beach, 1 ♂, June 19 (F. Haimbach) [A.N.S.P.].

The food plant of the type series is *Iva frutescens* L. I quote the following from Busck's description: "The larva at first mines the leaves; afterwards it feeds unprotected on the underside of the leaves. In the latter period it is dirty white with black hairs, head yellow with black eye marks and brown mandibles, tubercles polished white." On leaves of *Baccharis*, the mine is a short linear track, most conspicuous by the line of black frass within it. Exposed larvae feed on either the upper or lower side of the leaf forming irregular small patches, with either epidermis left intact. Moulting cocoon a thin sheet of lustrous papery white silk. When full-fed, the larvae commonly spin the slender, 6 or 7-ridged white cocoons over the midrib on the upper surface of the leaf; cocoons are also spun on nearby vegetation (cf. the New Jersey specimens).

B. ivella probably may be found in the salt marshes along the Atlantic Coast wherever its food plants occur.

The brief original description is inadequate for the identification of the species. Most of the specimens examined are darker than the type, in which many of the distinctive markings are obsolescent. In wing markings, this species is similar to *B. ambrosiaefoliella* Chambers and may be mistaken for it; in *ivella* the dark streaks are more oblique, and the white line above the fold is longer and more clear-cut. The most distinctive character of the male genitalia is the pair of hooks on the margin of tegumen; of the female genitalia, the pointed processes at margin of ostium, and especially the elongate signum with heavy teeth on some ribs, a character discernible under low power.

- (35) ***Bucculatrix ambrosiaefoliella*** Chambers (Figs. 118, 119, 119a.)
 1875. *Bucculatrix ambrosiaefoliella* Chambers, Cin. Quart. Journ. Sci. II: 119. Type, Kentucky (? Covington) [M.C.Z., Type No. 1307].
 1878. *Bucculatrix ambrosiaefoliella* Chambers, Bull. U. S. Geol. and Geogr. Surv. of Terr. IV: 115, 116.
 1882. *Bucculatrix ambrosiaefoliella* Chambers, "Notes on the larva of *Bucculatrix ambrosiaefoliella*," Canad. Ent. XIV: 153-160.
 1923. *Bucculatrix ambrosiaefoliella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., 158.
 1876. *Bucculatrix rileyi* Frey and Boll, Stett. Ent. Zeit. XXXVII: 219. Type ♂, Dallas, Texas [B.M. ?]. (**New synonymy.**)

Face whitish, tuft whitish, median hairs brown, or grayish brown; eye-caps white, antennal stalk, except at base, with alternate equal annulations of white and dark brown. Thorax ochereous, dusted with dark brown. Fore wings usually so densely overlaid with ochereous, ochereous brown-tipped and dark brown scales as completely to obscure the basic whitish ground color; costa from base to one-third brown, the brown color diverging at one-third to form a short triangular oblique streak, bordered outwardly by paler scales; at about the middle of costa an oblique dark brown streak crosses the wing blending with the dark brown area of termen and tornus; black scales at apex and on termen below apex; following the oblique brown streak, an oblique but slightly curved white streak, usually immaculate, and often the most conspicuous pale mark on the wing, passes to the middle of the wing, there ending in a few pure white scales, which give it the suggestion of a hook (this mark is often less clearly defined); costal apical area and cilia whitish, marked with several oblique lines of brown-tipped scales; from base just within the costal margin, a short pale ochereous or whitish streak; a streak of brown scales follows the fold for one-third the wing length, and bears on its dorsal side scattered raised scales; on dorsum near base, a few dark brown raised scales; just beyond middle of dorsum, a dark brown and ochereous semi-oval or broad half-crescent-shaped spot, its margin toward

base bearing black raised scales, is preceded by a curved ochreous or whitish streak which may be narrowly continued around the brown spot and enclose it; a slightly sinuous line (concave below apex) of brown and minutely black-tipped scales extends from the whitish costal cilia toward tornus. Hind wings and cilia reddish gray-brown. Anterior legs fuscous shaded, tarsal segments broadly dark-tipped; posterior legs pale, tarsal segments narrowly dark-tipped. Abdomen pale lustrous beneath, fuscous above.

Alar expanse 7.5 to 8 mm.

Male genitalia (fig. 118). Unique and characteristic; sacculus of harpe a blunt rounded lobe indenting anellus, cucullus attenuated, its tip with short heavy modified setae, costal prong weakly articulating with transtilla, transtilla broken in middle, the ends fimbriate; socii, pendulose lobes directed ventrally, prolonged posteriorly along tegumen as narrow transversely furrowed rods; anellus a broad tube; aedeagus stout, long, bent and tapering, vesica with a multitude of minute cornuti; vinculum asymmetric, left half narrow, right half produced anteriorly, twice the breadth of left half. Scale sac large, somewhat irregular in outline; scales elongate.

Female genitalia (figs. 119, 119a). Posterior and lateral to ostium on segment 8, circular areas of which the inner half circle (i.e. toward median line) is a free, dark-pigmented flap; toward lateral margin of tergite of 8 on each side a tuft of long scales; short specialized scales on intersegmental membrane beneath lobes of 7 on each side of the wide ostium; bursa copulatrix nearly filling the body from middle of segment 2 to middle of 5; signum a ring slightly constricting the bursa, spines of signum ribs, see Figure 119a; ductus bursae membranous from bursa copulatrix to anterior margin of 6, sclerotized in 6 and 7, and gradually widening to middle of 7, then abruptly enlarging to ostium.

Specimens examined.—65 or 70, representing both sexes.

KENTUCKY: Covington (?), type, reared on *Ambrosia* [M.C.Z.]; Powell County, 1 ♀, "probably on *Solidago*," imago Oct. 24, 1941 (A. F. Braun) [A.F.B.Coll.].

OHIO: Cincinnati, 1 ♂, 2 ♀, on *Ambrosia artemisiifolia* L., rearing record B.1222, imagoes Sept. 9 to Sept. 19; 3 ♂, on *Helianthus maximiliani* Schrad., rearing record B.1221, imagoes Sept. 9; 7 ♂, 8 ♀, August 24 to November 15 (A. F. Braun) [A.F.B.Coll.]; 1 ♂, Oct. 8, 3 ♀, Aug. 28, Sept. 17, Sept. 29 (A. F. Braun) [A.N.S.P.]; Brown County, 2 ♀, on *Ambrosia artemisiifolia*, rearing record B.2213, imagoes Sept. 12, Sept. 26 (A. F. Braun) [A.F.B.Coll.].

PENNSYLVANIA: Oak Station, Allegheny County, New Brighton, and Pittsburgh, 11, ♂, ♀, September [U.S.N.M.]; Oak Station, 1 ♂, June 12 (Fred Marloff) [Cornell U.]; Girard, 1 ♀, Oct. 10 (J. R. Eyer) [J.R.E.Coll.].

MISSOURI: Cross Keys, 2 ♂, "*Helianthus tuberosa*," "Artichoke," imagoes Aug. 23, Oct. 31; Blackjack, 2 ♀, "*Helianthus tuberosa*," imagoes Oct. 10, Oct. 18; 1 ♀, "reared from Artichoke," November 7 (all Webster Groves, and determined by Satterthwait as this species) [U.S.N.M.]; Webster Groves, 1 (sex

not determined), on sunflower, 8/15/30 (Satterthwait) [U.S.N.M.]; 2, "on sunflower," 8/10/96 (Riley Coll.) [U.S.N.M.]; several of the Riley Collection without data [U.S.N.M.].

IOWA: Sioux City, 2 ♂, 3 ♀, July and September (C. N. Ainslie) [U.S.N.M.]; 1 ♀, "Taken from sunflower," August 4, 1916, with white cocoon (C. N. Ainslie) [U.S.N.M.].

TEXAS: 1 specimen, lacking head, right fore wing, and abdomen, "827, 8.X, From Boll, Texas, *B. rileyella*" [U.S.N.M.]; Brownsville, 1 ♀, "Bred from Ambrosia, Jan. 23, 09" (McMillan and Marsh Coll.) [U.S.N.M.].

CALIFORNIA: Loma Linda, San Bernardino County, 1 ♂, March 8-15 [U.S.N.M.]. (Identification verified by slide of genitalia.)

No LOCALITY: several, "on ambrosia, 3/29/95 in warm room"; 2 (sex not determined), "Bucculatrix on Ambrosia," slender white cocoon, 3/19/93; several without data (Fernald Coll.) [U.S.N.M.].

The recorded food plants of *B. ambrosiaefoliella* include *Ambrosia artemisiifolia* L., *A. trifida* L., and several species of *Helianthus*. Chambers (1882, loc. cit.) describes the life history of this species in considerable detail; "the larva . . . makes at first a short, tortuous, linear mine, which ends in a small blotch, with the frass in compact lines." Chambers assumes only one instar wholly in the mine, the larva moulting but once in the mine, and feeding in the mine for about a day after this moult, then leaving the mine and feeding externally for about two days. [It is probable that earlier moults within the mine were not observed.] Following these two days of external feeding "it spins beside a rib a thin sheet of white silk, beneath which it spins a cocoonet, in which it again assumes the horse-shoe shape, and passes in about a day to second moult. Emerging from its cocoonet, it continues to feed externally for three days, when either on the plant or near to it, it spins its ribbed cocoon, in which it passes the pupa state." If Chambers' observations are correct, and only one moulting cocoon is spun after leaving the mine, it would appear that the larva spends part of the penultimate instar in the mine. Chambers describes the larva after the last moult in the mine as "striped longitudinally; there is a dorsal green stripe, margined on each side by a white line, beneath which is another green stripe on each side, containing on each segment two white spots placed obliquely, the lower spot being the largest . . . the larva frequently has a faint pink tinge, and the longitudinal stripes, which are very faint at first, become darker with age." Notes under rearing record B.2213 describe the last instar larva as reddish; a broad

mid-dorsal reddish stripe with a greenish narrower stripe each side of it, its lower edge wavy, and setal areas and spiracles greenish. These markings will distinguish the larva of *B. ambrosiaefoliella* from that of *B. agnella* when both are feeding together on the same plant.

The slender cocoon is white, with six or seven fine ridges.

The moths appear from late summer into October, and probably hibernate; however, moths are seldom collected in spring.

The left fore wing of the specimen in the United States National Museum, labeled "*B. rileyella*, From Boll, Texas," which lacks head, right fore wing and abdomen, agrees exactly with Frey's description of *rileyi*, and with specimens reared on *Ambrosia* and *Helianthus*, and thus substantiates the synonymy.

In wing markings, *Bucculatrix ambrosiaefoliella* resembles *B. ivella* Busck; the slightly sinuate ciliary line separates it from that species. The unusual male genitalia resemble no other species, and diverge in several respects from the usual pattern of the genus, notably in the asymmetric vinculum (a character checked by examination of several slides), the unusual socii, and the well-defined transtilla. Some characters of the female genitalia appear to ally it to the group of species with modification of the ovipositor for rasping or piercing and transfer of its function to the terminal portion of the vagina.

B. ambrosiaefoliella has been confused with *pomifoliella* Clemens, which appears early in the season. The fore wing of *pomifoliella* is somewhat broader, and in *pomifoliella* the outer margin of the dark streak from costa to termen is straight, and is not followed by a whitish hook-like mark.

(36) ***Bucculatrix pallidula*** new species (Figs. 56, 56a, 120, 120a.)

Face creamy white, tuft with mingled creamy white and reddish ocherous hairs; antennae creamy white, stalk with pale gray annulations. Thorax and fore wings creamy white, dusted with pale ocherous scales, some of which are minutely brown-tipped; no defined marks; the brown-tipped scales are more numerous in the outer half of the costal area, and form a short ill-defined longitudinal streak before apex; cilia whitish, with a few dark-tipped scales irregularly placed along termen. Hind wings whitish ocherous, slightly irrorate. Legs whitish ocherous, posterior tarsal segments minutely dark-tipped. Abdomen pale whitish ocherous.

Alar expanse 5.5 mm.

Female genitalia (figs. 120, 120a). With few specializations; apophyses long; near posterior lateral margin of 8 a cluster of long slender hair-like scales; ostium circular, its ventral margin sclerotized and slightly produced laterally; bursa copulatrix very small, signum a ring, narrow dorsally, signum ribs very narrow, with widely spaced sharp spines, membrane between the ribs lightly sclerotized and rugose.

Type.—♀, Zion Canyon, Utah, rearing record B.1205, on a "labiate shrub," imago August 9, 1924 (A. F. Braun) [A.F.B.Coll.].

The mined leaf was collected July 24 in Zion Canyon with the notation "labiate shrub" but without definite determination. The larva is a miner throughout larval life. The mine (fig. 56), a translucent blotch arising in the angle between two main veins at the base of the leaf, gradually enlarges wedge-shaped with the frass concentrated toward the narrow end. Spinning takes place immediately on leaving the mine; the cocoon (fig. 56a) is brownish ochereous, stout, about 4 mm. long, with six low ridges, the two lateral scarcely discernible.

The pale color and lack of any defined wing markings characterize this species.

(37) ***Bucculatrix taeniola*** new species (Figs. 11, 121, 121a, 122, 122a, 122b.)

Face white, dotted with fuscous; tuft fuscous, darker in the center, with a faint rufous tinge; eye-caps white, sometimes fuscous-dotted; stalk pale gray with fuscous annulations. Thorax irrorated fuscous. Fore wings (fig. 11) irrorated fuscous, with white transverse bands and a white costal triangle at apex; at one-third, a transverse, nearly perpendicular, slightly convex white band, usually broadest near costa, and margined outwardly near dorsum by black scales; beyond middle, a somewhat more irregular transverse white band, marked with a few lines of fuscous scales; just before apex, a white triangle, which, on its inner side, may be encroached upon by the fuscous scales of the ground color; median area of wing between the two transverse bands usually darker than the rest of the wing; scales at extreme apex of wing and along termen broadly black-tipped; cilia, except costal cilia, gray. Hind wings and cilia gray, somewhat irrorated. Legs gray shaded with dark fuscous; tarsal segments black-tipped. Abdomen silvery fuscous.

Alar expanse 7 mm.

Male genitalia (figs. 122, 122a, 122b). Harpes slender, nearly parallel-sided with short heavy setae at apex, long setae below apex; socii columnar, short setae at apex, long decumbent setae below apex; anellus conical, aperture oblique; aedeagus slender, elongate, curving to tip; vinculum emarginate anteriorly. Scales of scale sac (fig. 122b) broad club-shaped.

Female genitalia (figs. 121, 121a). Segment 7 partially overlying segment 8; in lateral depressed pockets of the intersegmental membrane adjacent to the anterior margin of sternite of 8, dense patches of dark-pigmented specialized scales; lateral to ostium, a cluster of strong setae; near posterior margin of 8, a lateral group of specialized scales (removed on the left side); ostium circular, its ventral margin strongly sclerotized and produced laterally into two strong flanges truncate at the ends; signum, separated groups of closely placed spined ribs (fig. 121a).

Type.—♂, Salinas, California, "reared on white sage, Feb. 26, 1938." Genitalia slide by Busck "AB, Apr. 25, 1938" [U.S.N.M., Type No. 65024].

Allotype.—♀, Mt. Wilson, California, March 5, 1925 (E. L. Braun) [A.F.B. Coll.].

Paratype.—1 ♀, S. Luis Obispo, California, March (A. H. Vachell) [U.S.N.M.].

"White sage" is the common name of *Salvia apiana* Jepson (*Audibertia polystachya* Benth.) in California; *Eurotia lanata* (Pursh) Moq. (Chenopodiaceae) is also sometimes called white sage. Thus the correct name of the food plant of *B. taeniola* is in doubt. Genitalia would seem to ally it to the Composite feeders.

The characteristic pattern of the markings of the fore wings separates this species from all others of our fauna.

(38) ***Bucculatrix carolinae*** new species (Figs. 123, 123a, 123b.)

Face grayish brown, scales darker-tipped; tuft dark brown, a few paler hairs laterally; eye-caps small, pale grayish ochereous, antennal stalk dark fuscous, with faint paler annulations. Thorax and fore wings brownish ochereous. Fore wing darkened along costa from base to three-fifths in a gradually widening area, which at three-fifths passes obliquely across the wing as a line of dark scales to termen above tornus, there meeting a line of black scales bordering termen toward apex; on costa this darkened area forms the inner margin of a triangular whitish spot; scales along dorsum minutely dark brown-tipped; beyond middle of fold, a short longitudinal black spot, the scales basad of it slightly paler than the general ground color, those bordering it below faintly orange-tinged; a faint paler spot at tornus preceding the terminal line of black scales; an elongate black apical spot bordered on its inner (costal) side by whitish scales; cilia brownish ochereous around apex, shading to gray on dorsum; a line of dark-tipped scales encircles the apex, and continues as a broken line toward tornus. Hind wings and cilia dark gray. Legs pale gray, tarsal segments whitish, conspicuously dark tipped.

Alar expanse 8.4 mm.

Female genitalia (figs. 123, 123a, 123b). Segment 7 overlying the base of segment 8, the margins of its sclerotized anterior half clothed with very long slender scales, its membranous posterior half with two thin curved lobes; sclerotized lateral margins of ostium produced as narrow branching plates; tergite of 8 specialized, two sclerotized bands joining mid-dorsally, and a median longitudinal furrow; sclerotized section of ductus bursae near ostium followed by a membranous section in which the ductus seminalis enters; signum the typical spined ring, ribs closely placed.

Type.—♀, Cherry Hill Recreation Area, Rte. 107, 2000°, Oconee County, South Carolina, Sept. 5, 1958, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U., Type No. 3643].

Food plant and early stages unknown.

The brownish ocherous fore wings, immaculate in the basal three-fifths, characterize this easily recognized species and separate it at once from all other described North American species. The lobes of the membrane of segment 7 and the specialized tergite of segment 8 are distinctive characters.

(39) ***Bucculatrix angustata*** Frey and Boll

(Figs. 45, 45a, 125, 126, 126a, 126b.)

1876. *Bucculatrix angustata* Frey and Boll, Stett. Ent. Zeit. XXXVII: 218.

Type, Dallas, Texas [Location of type unknown].

1916. *Bucculatrix crescentella* Braun, Canad. Ent. XLVIII: 140. Type ♂, Cincinnati, Ohio, from larva on *Aster* sp., rearing record B.803, imago June 11, 1914 (one of the series on which the original description was based) [A.F.B.Coll.]. **New synonymy.**

1920. *Bucculatrix crescentella* Barnes and Busck, Contrib. Nat. Hist. Lepid., IV, Plate XXXIX, fig. 7 (♂ genitalia).

1923. *Bucculatrix crescentella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., 159.

1925. *Bucculatrix crescentella* Braun, Trans. Amer. Ent. Soc. LI: 222.

Face white, tuft whitish, median line brown; eye-caps whitish, antennal stalk pale brownish white, with dark brown annulations toward apex. Thorax pale to dark brown, median area usually darker. Fore wing pale whitish brown to dark brown (especially in female); from base just above fold a narrow white longitudinal streak attaining half the wing length and indistinctly prolonged to three-fifths the wing length, margined below, especially in its outer half, with dark brown scales contrasting with the paler area dorsad of fold; from before middle of costa a very oblique white streak curves to middle of wing; beyond it a less oblique white streak, at its tip a black dot or a short longitudinal streak of a few black scales, often continuous with the inner dark margin of the white

streak, but at an obtuse angle with it; before apex a triangular white streak which may encircle the irregular blackish apical spot; on middle of dorsum a pair of curved white streaks delimiting or enclosing a usually crescent-shaped mark, typically conspicuously darker than the general ground color, but sometimes concolorous with it; rarely both the dark crescent and the whitish scales may be scarcely differentiated from the pale ground color; whitish hairs in cilia of termen form an ill-defined whitish streak; a line of dark-tipped scales curves around apex through the pale cilia. Hind wings and cilia pale brownish gray, apical cilia paler and sometimes whitish. Legs pale brownish gray, tarsal segments black-tipped. Abdomen above whitish to dark brown.

Alar expanse 7 to 9 mm.

Male genitalia (figs. 126, 126a, 126b). Harpe slender, setose before the sharp-pointed apex, costa concave below apex; socii elongate, widely separated, setose; anellus conical, notched at apex; aedeagus tapering to slender point from elongate entrance of penis; vinculum rounded. Scale sac with many small and broadly oval scales.

Female genitalia (fig. 125). Ostium in the intersegmental membrane, its margin sclerotized and flaring; specialized scale tufts on intersegmental membrane lateral to ostium and on segment 8 dorsad of lateral line; ductus bursae weakly sclerotized in posterior two-thirds; signum of radiating spined ribs, producing a flattened, somewhat leaf-shaped aspect.

Bucculatrix angustata Frey and Boll is a common and widespread species; its range extends from Nova Scotia westward to Manitoba and the State of Washington and southward to the Gulf States and Texas (type locality of *angustata*). Approximately 200 specimens, representing both sexes have been examined in the United States National Museum, Academy of Natural Sciences of Philadelphia, Canadian National Collection, A. F. Braun Collection, Cornell University Collection, A. E. Brower Collection, C. P. Kimball Collection and others. The provinces and states represented include Nova Scotia, Quebec, Ontario, Manitoba, Maine, Massachusetts, New York, Rhode Island, Pennsylvania, New Jersey, Ohio, Michigan, Kentucky, Tennessee, North Carolina, Mississippi, Iowa, Utah and Washington.

The recorded food plants include various Composites, principally several species of *Aster*, occasionally *Solidago*, and rarely *Erigeron* sp. The larvae are miners throughout larval life, never feeding exposed. Figure 45 illustrates the work of a single larva on a leaf of *Aster novae-angliae* L. The earliest mine is a long, linear, gradually widening track, which may become considerably broader than the example figured before the larva leaves it to form a second mine; small blotch-like

mines are occasionally made on leaving the linear mine; later mines are more or less trumpet-shaped. Cocoon (fig. 45a) white, slender, with six or seven fine ridges.

The dates of emergence of *Cincinnati* specimens from the latter part of April to late September indicate several generations, perhaps not sharply separated: one from overwintering pupae, a second with imagoes in June, a third appearing in late July, and a fourth in early autumn.

Frey, in his description of *angustata*, makes no mention of the dorsal dark crescent, nor of its whitish margining; his reference to a streak from the hind angle which meets a costal streak in apex may refer to the oblique whitish outer margin of this crescent, which sometimes diffuses toward apex.

The black dot or short longitudinal line of a few scales in the disc at the tip of the second costal streak is a good diagnostic character, and is especially noticeable in paler specimens and is often discernible in much worn and nearly denuded specimens; it is mentioned in Frey's description and supports the synonymy of *crescentella* with *angustata*.

(40) ***Bucculatrix adelpha*** new species (Figs. 124, 124a, 127, 127a, 127b.)

Face white, with faint ocherous tinge, tuft laterally whitish, shading through pale yellowish brown to dark brown centrally; eye-caps white, with faint ocherous tinge, antennal stalk dark brown, with paler annulations. Thorax brown, tegulae with a fine white lateral line continuing as the basal streak of the wing. Fore wing broader than in *angustata*, brown, somewhat darkened toward costa between the white costal streaks; from base of costa, a whitish longitudinal streak to one-fourth the wing length sometimes continues as a barely perceptible pale shade to one-third the wing length; before middle of costa an oblique white streak, and at two-thirds of costa a less oblique white streak, its inner dark margin prolonged along the disc as a black, usually irregular line; before apex a curved white streak extending into the white cilia above apex and usually enclosing an irregular black apical spot; before middle of dorsum a curved white streak, margined outwardly within the dorsal margin by black slightly raised scales, which may continue along the fold to the apex of a second white or whitish less oblique dorsal streak; rarely a white streak above tornus mostly in the cilia points toward the apex of the second costal streak and may nearly meet it; from apical spot a broken line of black-tipped scales along termen; a conspicuous line of black-tipped scales through cilia from the white costal cilia to tornus. Hind wings and cilia dark gray. Legs dark gray, tarsal segments pale at base and inwardly, tibial hairs pale gray. Abdomen dark fuscous above, paler beneath.

Alar expanse 8 to 9.4 mm.

Male genitalia (figs. 127, 127a, 127b). Harpe bilobed and broad at apex, the opposing surfaces with short heavy setae; socii elongate, widely separated, setose; anellus with a minute bilobed flap at apex; aedeagus broad at base, rapidly tapering to the two-valved apex; vinculum rounded anteriorly, a quadrate projection posteriorly. Scale sac present.

Female genitalia (figs. 124, 124a). Ostium in a basally broad sclerotized depression, with narrower posterior margin thickened; sclerotized basal half of segment 8 beset with minute spinules; short specialized scales at margin of intersegmental membrane beneath 7; ductus bursae weakly sclerotized near ostium; signum of long radiating spined ribs, becoming very short dorsally, producing a flattened somewhat leaf-shaped aspect.

Type.—♂, East Ottawa, Ontario, June 10, 1945, "Bred from *Aster cordifolius*" (J. H. McDunnough) [C.N.Coll., Type No. 7176].

Allotype.—♀, Ottawa, Ontario, July 10 (C. H. Young) [C.N.Coll., Type No. 7176].

Paratypes.—4 ♂, Merivale, Ontario, June 25, 1956, reared on *Aster*, cocoons accompanying (G. G. Lewis); 1 ♂, Bobcaygeon, Ontario, June 29, 1931 (J. McDunnough); 1 ♂, Hull, Quebec, June 20, 1955 (T. N. Freeman); 2 ♂, Smith's Cove, N. S., July 19, July 20, 1945 (J. McDunnough) [all C.N.Coll.].

No details of larval habits are available; the white cocoons, which accompany reared specimens, are similar to those of *angustata* Frey and Boll.

B. adelpha is the nearest ally of *angustata*, closely resembling it in wing markings and agreeing with it in the unique signum, but differing from it in the broader fore wings, and short basal longitudinal streak which never attains the mid-length of the wing. In genitalia, the very differently shaped harpe, and the sharply defined sclerotized area into which the ostium opens at once differentiate it from that species.

(41) ***Bucculatrix plucheae*** new species (Figs. 128, 128a, 129, 129a.)

Face whitish, tuft whitish ochreous, brown centrally; eye-caps whitish, antennal stalk whitish at base, shading outwardly to dark brown. Thorax and fore wings brown. From base of wing, a narrow straight white streak, bordered on each side by a single line of blackish brown scales, extends parallel to the fold for nearly half the wing length; from basal third of costa, an oblique white streak, and just beyond middle of costa, a broader, triangular white streak attains the middle of the wing; before apex, a third white streak, sometimes encircling the apex, extends into the whitish costal cilia; at middle of dorsum, a slightly curved white spot, and just before tornus, a white spot, variable in size and somewhat diffuse, the cilia opposite it white; a few black scales at apex and

a line of black-tipped scales through the middle of the cilia, terminating at the whitish cilia at tornus. Hind wings and cilia dark grayish brown. Legs fuscous, except hind tibiae, which are white except at base and apex. Abdomen fuscous above, paler beneath.

Alar expanse 5 mm.

Male genitalia (figs. 128, 128a). Harpe tapering to acute apex, margin of costa concave below apex, heavy short setae at apex; socii two long arms arising low down, the tegumen between them merely a narrow sclerotized band connecting their bases; anellus constricted near base, with a sclerotized acutely angled process dorsally; aedeagus broad at base rapidly tapering to the slender tip; vinculum quadrate. Scale sac with round scales.

Female genitalia (figs. 129, 129a). Ostium in a broad saucer-shaped microscopically spinulose depression at the anterior margin of segment 8; bursa copulatrix elongate, extending from the anterior margin of segment 5 into segment 2; signum a ring at the posterior end of bursa, spines of signum ribs short, abruptly pointed, an occasional minute spine between the ribs (fig. 129a).

Type.—♂, Key West, Florida, "ex *Pluchea odorata*, 26 April, 1945, Lot 45-10176, ss24349" [U.S.N.M., Type No. 65025].

Allotype.—♀ (lacking right wings), same data as the type [U.S.N.M.].

Paratypes.—1 ♀, Oneco, Manatee County, Florida, May 5, 1953 (Paula Dillman, Coll. C. P. Kimball) [A.N.S.P.]; 1 ♀ (lacking hind wings and abdomen), Siesta Key, Sarasota County, Florida, November 6, 1952 (C. P. Kimball) [A.N.S.P.].

Although none of the specimens is in perfect condition, all are recognizable. The fore wings of the female paratype from Siesta Key show all the markings described. The wings of the male type are unspread and the white tornal spot is obscured on both wings.

Cocoons (accompanying the reared specimens) are grayish or whitish ochereous, with well-defined ridges.

The food plant, *Pluchea odorata* Cass., is widespread in Tropical America; its range given by Small, "Manual of the Southeastern Flora," is "S. Pen. Fla. and the Keys," . . . "W. I., Mex., C. A., S. A."

B. pluchae is closely allied to *B. angustata* Frey and Boll (syn. *crescentella* Braun), in general agreeing with it in wing markings; the shape of harpe and the long socii further indicate the relationship; in female genitalia the broad depression into which the ostium opens and especially the very different signum amply differentiate this species from *angustata*.

(42) **Bucculatrix eupatoriella** Braun (Figs. 25, 26, 130, 131, 131a.)

1918. *Bucculatrix eupatoriella* Braun, Ent. News XXIX: 247. Type ♀, Cincinnati, Ohio [A.F.B.Coll.].

Face yellow, tuft ochereous in front, shading to reddish brown posteriorly; eye-caps small, yellowish, antennal notch in male slight, stalk brown, indistinctly annulate. Thorax and fore wings bright brownish ochereous, occasionally approaching a uniform brown; markings brilliant silvery. An oblique silvery streak at basal third and a second at two-thirds of costa, between which the ground color may be somewhat darker especially at the inner margin of the second streak; on dorsal margin, a little basad of the first costal streak, a curved silvery spot, followed by a large patch of dark brown raised scales; opposite the second costal streak, a pair of nearly confluent silvery dorsal streaks, the first margined inwardly, the second outwardly with black-tipped scales; in cilia above apex, a broadly triangular creamy white spot; at apex, a small silvery transverse spot, followed by a minute black spot at extreme apex; cilia gray, with a row of dark brown-tipped scales extending through them from the white costal spot to dorsum. Legs gray-brown, base and apical fourth of posterior tibiae and spurs blackish, mid-portion and hairs whitish, tarsal segments dark-tipped. Abdomen fuscous above, lustrous yellowish white beneath.

Alar expanse 5 to 6.8 mm.

Male genitalia (fig. 130). Harpe slender, broadly expanding at apex, cucullus bilobed, each lobe armed with strong setae; socii setose, diverging, tapering to pointed apices; uncus present, hood-like; anellus elongate, contracting and weakly sclerotized toward apex; aedeagus tapering, curving to the two-valved aperture; vinculum broadly rounded. Scale sac present.

Female genitalia (figs. 131, 131a). Ventral anterior margin of ostium strongly sclerotized, posteriorly the lateral margins terminating in free curved pointed projections directed obliquely ventrally; segment 8 lateral to ostium densely scaled; signum the typical ring of spined ribs, much wider ventrally.

Specimens examined.—33, representing both sexes.

OHIO: Cincinnati, ♀ type, 23 paratypes, rearing record B.955, from larvae and cocoons on *Eupatorium perfoliatum* L., collected August 13, producing imagoes from August 16 to August 24, 1917 (A. F. Braun) [A.F.B.Coll. and A.N.S.P.]; 2 ♀ paratypes, August 3, 1917, and September 1, 1905 (A. F. Braun) [A.F.B.Coll.]; Adams County, 1 ♂, 3 ♀, rearing record B.955, from larvae on *Eupatorium perfoliatum* L., imagoes August 21 to September 12, 1928; Grant Lake, Brown County, 2 ♀, rearing record B.2275, from larvae on *Eupatorium perfoliatum* L., collected August 28, imagoes September 18 and September 22, 1957 (A. F. Braun) [A.F.B.Coll.].

NORTH CAROLINA: Balsam, Jackson County, 1 ♀, July 22, 1911 (A. F. Braun) [A.F.B.Coll.].

A single leaf of the food plant may contain twenty or more of the long, linear and much-contorted mines. The larvae on leaving the mines form scattered small eaten patches with the upper epidermis intact; later the leaf may be riddled with holes when a number of larvae feed on a single leaf. The short white cocoons, with four well-defined ridges and an inconspicuous ridge on either side, and well-differentiated anterior section in which only the two central ridges are well-defined, are commonly spun on the underside of the leaf, usually against the midrib.

Besides the late summer generation of which the larvae are extremely plentiful, as described above, there is probably a later generation, passing the winter in the pupal state with imagoes emerging in the spring. A third generation, from eggs laid on the food plant in spring, consists of few individuals, the moths appearing in early July.

B. eupatoriella is easily distinguished both by wing pattern and genitalia from all described North American species. Its nearest ally is *B. polymniae* new species.

(43) ***Bucculatrix polymniae*** new species

(Figs. 9, 36, 47, 132, 132a, 133, 133a.)

Face creamy white, hairs of tuft creamy white, fulvous and dark brown; eye-caps creamy white, antennal notch of male absent, replaced by a scarcely perceptible excavation, and thus this segment more slender than the succeeding segments and more slender than the corresponding segment of the female, stalk dark brown with narrow pale annulations. Thorax and fore wings brown, the wings darkest brown between the silvery streaks. From base of wing (fig. 9), a straight ochereous streak, parallel to fold, for two-thirds the wing length; from costa near base a very oblique ochereous streak joins the longitudinal streak at about one-fourth the wing length, thus enclosing a small patch of ground color; before middle of costa, an oblique silvery streak, a similar, but less oblique silvery streak at two-thirds; before middle of dorsum, a curved ochereous streak, more or less overlaid with silvery scales, is followed by a patch of blackish raised scales; before tornus, a very oblique silvery spot, and at tornus, an inwardly oblique narrow streak, its apex opposite the apex of the second silvery costal streak; a few silvery scales at apex; in cilia above apex, a creamy white triangular patch; a line of black overlapping scales extending obliquely from apex to tip of cilia; cilia gray, with a line of dark-tipped scales extending through them from tornus and curving in at apex to the base of the line of black scales from apex. Hind wings and cilia gray. Legs dark brown, hind tibiae,

except spurs and apical hairs, whitish ocherous and clothed with whitish ocherous hairs. Abdomen dark brown above, somewhat paler beneath, especially in male.

Alar expanse 6 to 7 mm.

Male genitalia (figs. 132, 132a). Harpe broad apically, indistinctly bilobed at apex, lobes with strong heavy short setae; socii large, with heavy curved setae; uncus present, narrow pointed, microscopically setose; anellus an elongate tube, aedeagus long, gradually narrowing and curving to apex; vinculum produced anteriorly to a rounded point. Scale sac large.

Female genitalia (figs. 133, 133a). Ostium circular, ductus bursae forked in segment 7, the forks entering bursa separately; lateral to ostium, oval patches of specialized scales on intersegmental membrane; posterior ventral margin of 7 with lateral pointed projections and a quadrate projection mid-ventrally; signum a ring of spined ribs, the ribs irregularly spined, an occasional spine conspicuously larger (fig. 133a).

Type.—♂, Clack Mountain, Rowan County, Kentucky, from larva on leaves of *Polymnia uvedalia* L., collected August 26, 1946, rearing record B.2101, imago September 8, 1946 (A. F. Braun) [A.F.B.Coll.].

Paratypes.—5 ♂, 5 ♀, same data as the type, except dates of emergence September 3 to September 9; 1 ♂, 1 ♀, larvae collected October 4, rearing record B.2101, imagoes March 29, 1946; 5 ♂, 13 ♀, Fort Hill, Highland County, Ohio, from larvae collected August 24 on leaves of *Polymnia uvedalia* L., rearing record B.2221, imagoes September 1 to September 6, 1955; 1 ♂, 3 ♀, Fort Hill, Highland County, Ohio, rearing record B.2221b, imagoes March 29 to April 11, 1957; 1 ♀, Fort Hill, Highland County, Ohio, larva collected June 28, rearing record B.2221a, imago July 5, 1956; 1 ♀, Pike Lake, Pike County, Ohio, larva on *Polymnia uvedalia*, collected October 2, rearing record B.2204, imago March 30, 1954 (A. F. Braun) [A.F.B.Coll.].

Bucculatrix polymniae is confined to *Polymnia uvedalia* L. as a food plant, and the larvae, especially of the late summer and fall generations, may be present in great numbers. Three generations a year: larvae mining in June only in the lowest pair of leaves and producing imagoes in early July; a second generation of larvae in the latter part of August producing imagoes in early September; a third generation feeding in October, passing the winter in the pupal state with imagoes in early spring.

The egg (fig. 36) deposited on the upper surface of the leaf, is ovate, tapering slightly toward the micropylar end, its surface marked with brilliantly iridescent wavy bars and knobs, the knobs arranged in concentric arcs toward the micropylar end.

On the very thin leaves of the food plant the irregularly winding mines may be as much as 5 or 6 cm. long, with a fine central line of frass. The white papery moulting cocoons are spun on the underside of the leaf. The leaves are skeletonized in irregular patches; in the last instar the larva may consume an area of 2 square centimeters. The larvae are pale green with a faint reddish tinge anteriorly, nearly concolorous with the under surface of the leaf.

The white cocoons, often spun against the midrib or near the base of the petiole, are short, rounded at either end, with two prominent ridges twisted diagonally, and sometimes a partial third ridge (fig. 47).

The apical pencil of overlapping scales (easily lost) and the ciliary line incurving to apex of the wing are unique and distinctive characters.

B. polymniae is closely allied to *B. eupatoriella* in larval habits, in wing markings, and in genitalia of both sexes, but with the female genitalia somewhat more specialized.

(44) ***Bucculatrix speciosa*** new species (Figs. 46, 46a, 46b, 46c, 136, 136a.)

Face creamy white, tuft with a few creamy white hairs toward face, and shading from reddish brown to dark brown posteriorly and centrally; eye-caps creamy white, very small, on basal half fringed with long hairs, antennal stalk dark brown, narrowly paler-annulate. Thorax and fore wings dull brown, except the basal dorsal area below the fold to first dorsal pale spot dull grayish ocherous. From base of costa to fold a small pale ocherous spot; an oblique white costal spot at three-eighths, a second similar white spot at five-eighths; a larger curved white spot before middle of dorsum, its apex directed toward the first costal spot, is followed by a blackish patch of slightly raised scales; a triangular white spot before tornus; at apex a white spot connected with a patch of creamy white cilia on costa, is followed by a small black spot; cilia, except the costal, reddish brown, marginal scales projecting irregularly into them along termen. Hind wings fuscous, cilia reddish. Legs dark brown, tips of tarsal segments pale, tibial hairs brown and pale ocherous. Abdomen dark fuscous above, whitish beneath, dusted with gray.

Alar expanse 8 to 8.5 mm.

Female genitalia (figs. 136, 136a). Segment 7 deeply indented mid-ventrally, less deeply indented laterally by oval depressions of the intersegmental membrane filled with dark specialized scales; the membranous ductus bursae expands before ostium which opens into a large nearly circular depression on segment 8; flat fan-shaped tufts of long slender scales laterally at margin of sclerotized portion of segment 8; lateral to the circular depression lines of strong short setae and clusters of minute setae; ribs of signum with abruptly acicular spines and an occasional broad large spine (fig. 136a).

Type.—♀, Cranberry Glades, Pocahontas County, West Virginia, from larva on leaves of *Solidago* sp., September 24, 1938, rearing record B.1687, imago April 15, 1939 (A. F. Braun) [A.F.B.Coll.].

Paratype.—♀, same data as the type, except date of emergence March 31.

Larvae and several cocoons were collected at Cranberry Glades on a species of *Solidago* just within the woodland border of the bog. The linear mine is 4.5 cm. or more in length; on leaving the mine, the larva feeds on the underside of the leaf, the eaten patches gradually increasing in extent with the growth of the larva; moulting cocoons of pure white thin papery silk (figs. 46a, 46b). The very slender elongate white ribbed cocoon (fig. 46c) may be spun on a stem of the food plant near the inflorescence, on the underside of a leaf, or on debris on the ground.

Both wing markings and female genitalia suggest close relationship to *B. sexnotata* Braun.

(45) ***Bucculatrix subnitens*** Walsingham (Figs. 137, 137a.)

1914. *Bucculatrix subnitens* Walsingham, Biologia-Centrali-Americana, IV, Lepidoptera-Heterocera, p. 345, Fig. 2, Pl. X. Type ♂, Teapa, Tabasco, Mexico [B.M.].

Face whitish, tuft brown centrally, whitish laterally; eye-caps whitish, antennal stalk gray, with narrow darker annulations. Thorax and basal half of fore wing uniformly ochereous, except for a dark brown stripe along costa, broadening at basal fourth to form an oblique streak, concave outwardly; in the middle of the disc, the ochereous color is produced as a narrow streak to two-thirds the wing length, thus deeply indenting the reddish or dark brown and blackish outer half of the wing; just before middle of costa, a curved lustrous silvery streak; at two-thirds of costa a triangular erect, or sometimes narrow and oblique silvery spot; at middle of dorsum, a large curved dark brown and black streak bearing black raised scales, its tip reaching just beyond the acute tip of the narrow ochereous streak through the middle of the wing; this dark brown streak is bordered on each side by a patch of lustrous silvery scales extending to the fold; a whitish spot at tornus a little distad of the second silvery costal spot; scales encircling the apex grayish ochereous, and black-tipped; just before apex on costa, a white spot mostly in the cilia, a similar less defined pale spot just below apex is connected to the costal white spot by two or three silvery white scales; some dark brown scales project into the cilia; cilia gray toward tornus. Hind wings and cilia fuscous, somewhat irrorated. Legs dark brown, tibial hairs of the hind legs pure white. Large latero-dorsal blackish spots on metathorax. Abdomen dark fuscous, anal scales whitish ochereous.

Alar expanse 5 to 7 mm.

Female genitalia (figs. 137, 137a). Ovipositor lobes minutely spinulose between the setae; anterior half of segment 8 strongly sclerotized, near the posterior lateral margin of this sclerotized eighth sternite, a cluster of setae; a lateral pair of elongate pockets on the intersegmental membrane indenting segment 8, and bearing dark-pigmented specialized scales; ductus bursae opening into broad heart-shaped depression, sclerotized to the middle of segment 7, inception of ductus seminalis at the junction of this sclerotized section with the long membranous anterior section; the small bursa copulatrix at the anterior end of the abdomen and strongly constricted by the signum, ribs of signum so closely placed that the spines of one rib overlap the adjacent one; spines acute, an occasional broader and larger spine (fig. 137a).

Specimen examined.—1 ♀.

ARIZONA: Madera Canyon, 4880 feet, Santa Rita Mountains, 1 ♀, 30 June, 1959 (R. W. Hodges) [Cornell U.].

Food plant and early stages unknown, but without doubt the larva should be sought for on some Composite.

Walsingham does not mention the silvery spot on the basad side of the dorsal dark streak; the incidence of light affects the distinctness of both of these spots. On the single Arizona specimen, I do not find a silvery white spot on the thorax, but the tips of the tegulae are somewhat paler than the remainder of the thorax. The wing expanse of the male type (5 mm.) is considerably less than that of the Arizona female specimen (7 mm.).

This very distinct species can be recognized by wing color and markings.

Both by genitalia and wing marks, *B. subnitens* is allied to *B. sexnotata* Braun and *B. speciosa* new species; the wing marks are placed as in these species; it further agrees with *sexnotata* in the silvery luster of the pale marks.

Although the type locality of *B. subnitens* is 1500 or more miles from Arizona, there seems to be no doubt of the identification.

(46) ***Bucculatrix sexnotata*** Braun (Figs. 43, 43a, 134, 135, 135a.)

1927. *Bucculatrix sexnotata* Braun, Trans. Amer. Ent. Soc. LIII: 195. Type ♂, Natural Bridge, Powell County, Kentucky [A.F.B.Coll.].

Face shining yellowish white, tuft orange-red in front, shading to dark brown behind; eye-caps small, silvery white, antennal notch of male very shallow, antennal stalk fuscous in basal half, faintly paler annulate, in outer half paler

shading to white or whitish at tip, especially in female. Thorax and fore wings dark, almost black, faintly shining; the wings with six silvery white spots; a short oblique spot from base of costa to fold; oblique triangular costal spots before middle and at three-fourths; triangular dorsal spots at one-third and before tornus, each a little anterior to the corresponding costal spot; the sixth spot at apex and followed by a patch of blackish scales projecting into the cilia, from this a faint line of dark scales through the cilia along termen. Hind wings and cilia brown, slightly paler in female; frenulum of female with two bristles not closely associated. Legs dark brown, posterior tibiae with long dull ochreous hairs. Abdomen dark brown above, much paler beneath in female, tip pale ochreous.

Alar expanse 7 to 7.5 mm.

Male genitalia (fig. 134). Harpe with an outer curved setose lobe, apex with short heavy setae; socii very large, finely setose; anellus slender, conical, sclerotized; aedeagus curving from broad base to slender apex; vinculum moderately broad, rounded anteriorly. Scale sac present.

Female genitalia (figs. 135, 135a). Ostium small, circular, opening into a shallow sinus, margined by a strongly sclerotized horseshoe-shaped structure, its arms gradually broadening and attaining the posterior margin of the sclerotized basal half of segment 8; a patch of dark specialized scales each side of ostium on intersegmental membrane projects slightly beyond the posterior margin of 7; on dorsal posterior margin of 7 a dense line of scales, shorter than the lateral scales (not shown on figure); signum the usual ring of spined ribs, spines long, with an occasional larger spine (fig. 135a).

Specimens examined.—23 ♂, 25 ♀.

KENTUCKY: Natural Bridge, Powell County, ♂ type, ♀ paratype, rearing record B.1223, from larvae on *Aster divaricatus* L., September 12, 1924, imagoes April 18 and April 27, 1925 [A.F.B.Coll.].

NORTH CAROLINA: Thomas Ridge, Great Smoky Mountains National Park, 2 ♀, rearing record B.2198, larvae collected on *Aster divaricatus* L., August 2, 1953, imagoes April 26, 1954 [A.F.B.Coll.].

OHIO: Ash Cave, Hocking County, 3 ♂, 6 ♀, rearing record B.2091, larvae on *Aster prenanthoides* Muhl., September 29, 1943, imagoes April 12 to April 19, 1944 [A.F.B.Coll.].

PENNSYLVANIA: New Brighton, 1 ♀, July 10, '07 (Merrick Museum) [U.S.N.M.].

ONTARIO: 1 ♂, 3-VII, 1905 (C. H. Young) [C.N.Coll.].

NEW BRUNSWICK: Waweig, 1 ♀, 5-VII, 1933 (T. N. Freeman) [C.N.Coll.].

NOVA SCOTIA: Petite Riviere, 14 ♂, July 16, 19, 1935, 7 ♀, July 19, 1935; White Pt. Bch., Queen Co., 3 ♂, July 13, 16, 20, 1934; Smith's Cove, 3 ♀, July 19–20, August 6, 1945 (J. McDunnough) [C.N.Coll.]; Halifax Co., 4 ♀, 1 ♂, reared on *Aster novi-belgii* L., imagoes April 13 to 19, 1952 (J. McDunnough) [Nova Scotia Museum of Science].

The larvae make very long thread-like mines in leaves of several species of *Aster*, the early portion of the mine sometimes difficult to discern; three instars are passed in the mine; during the fourth and fifth instars (as indicated by the spinning of two moulting cocoons) the larvae feed exposed on the underside of the leaf, the upper epidermis remaining intact in the irregular eaten patches (fig. 43). Along the high ridges of the Great Smoky Mountains (on the Appalachian Trail at elevations between 5000 and 6000 feet), where *B. sexnotata* mines only the leaves of *Aster divaricatus*, the mines are sometimes so plentiful as to shrivel the leaves and disfigure the plants. However the high percentage of parasitism here (in 1953) resulted in emergence of scarcely 10% of the individuals. Cocoon (fig. 43a) slender, with six well-defined ridges; anterior section little differentiated, except that the ridges may be less distinct, or sometimes obsolete; pale grayish brown, occasionally whitish.

Bucculatrix sexnotata resembles in general character of wing markings the *Corylus*-feeder, *B. callistricha* new species, with which it has no relationship, as shown by genitalic structure. The characteristic genitalia of both sexes at once separate *B. sexnotata* from all other described American species.

Subsection B

- (47) ***Bucculatrix divisa*** Braun (Figs. 48, 48a, 48b, 48c, 138, 139, 139a.)
1925. *Bucculatrix divisa* Braun, Trans. Amer. Ent. Soc. LI: 221. Type ♂, near Logan, Utah [A.F.B.Coll.].

Face grayish white, tuft with intermingled white and grayish brown hairs, the white hairs predominating in pale specimens, the dark hairs in dark specimens; eye-caps whitish, with a longitudinal dark streak; antennal stalk pale gray, with dark brown annulations. Basic color of the fore wings whitish, shaded however with a varying amount of pale ashy gray, brownish ochereous or brown, and finally so completely suffused with dark brown as to obscure all the white markings except a narrow white line extending from two-thirds of costa across the wing to termen and a line of black-tipped white scales encircling apex. In specimens in which the white marks are defined (as in the type and paratypes) the wing is more or less suffused with brownish ochereous, the basal half sometimes contrastingly paler than the outer half; a whitish streak from base below costa to about one-third; before middle of wing, the brownish color forms the inner margin of a short white streak; from two-thirds of costa an

oblique white streak, sometimes broad on costa, crosses the wing to termen; this streak may be divided in the middle of the wing by a short brown or black dash; at middle of dorsum, a dark brown, sometimes basally blackish-edged broad half crescent or oval mark is margined before and behind by white; costa before apex usually whitish; a line of black-tipped white scales encircling the apex; a dark brown spot at apex. In very pale specimens, the white markings expand and contrast but little with the pale ashy or silvery gray ground; in such specimens the dorsal oval forms a conspicuous dark mark. Hind wings varying in color from pale silvery gray to blackish fuscous. Legs varying from whitish to dark gray, tarsal segments black-tipped. Abdomen pale gray to dark fuscous.

Alar expanse 8 to 9 mm.

Male genitalia (fig. 138). Harpe strongly sclerotized, inflated, abruptly tapering beyond middle to apex, strong setae at apex; tegumen bulging before socii, here incurved and lying in a dorso-ventral plane, contracting to the small widely separated setose socii; subscaphium a thin dorso-ventral plate near posterior median margin of tegumen; anellus a slender cone; aedeagus long, extending forward into segment 5, slender, sinuate; vinculum with a broad anterior sinus. Scale sac present.

Female genitalia (figs. 139, 139a). Segment 9 modified, long setae indicating areas homologous with ovipositor lobes; rasping rods developed, vaginal setae slender, rounded at tip; ostium in a funnel-shaped depression, its lateral flaring margins intricately and more or less hexagonally sculptured; inception of ductus seminalis at ostium, ductus bursae curving to the right, sclerotized nearly to the anterior margin of segment 6, entering bursa dorsally near its posterior end; signum with ribs closely placed, forming a dense collar near posterior end of bursa; spines long, evenly spaced (fig. 139a).

Specimens examined.—9 ♂, 4 ♀.

UTAH: Cache County, near Logan, ♂ type, 2 ♂ paratypes, rearing record B.1145, imagoes June 26, June 29 [A.F.B.Coll.].

WASHINGTON: Along Tieton River, west of Yakima, 3 ♂, 3 ♀, rearing record B.2291, imagoes July 13 to July 24 (A. F. Braun) [A.F.B.Coll.]; Clarkston, 3 ♂, 1 ♀, 1-III, '31 (J. F. Clarke) [U.S.N.M.].

Food plant: *Balsamorhiza sagittata* (Pursh) Nutt.

The early mine, formed on hatching from the egg, is at first indistinct, later translucent, and finally enlarges into a small irregular blotch; frass deposited in the mine (fig. 48a). On leaving this mine the larva feeds on the lower surface of the leaf, mining into the leaf, but with only head and thorax in the mine. Each larva makes several of these small squarish mines, never exceeding two millimeters across, the circular entrance hole placed at one side of the mine (fig. 48b); except for the position of the hole, the mines resemble small *Coleophora*

mines. The cocoons, which are spun on the underside of the leaf, commonly next to the midrib, vary in color from whitish to pinkish, rarely with a slight brownish shade; twelve to fourteen very fine ridges (fig. 48c); a slightly wooly texture sometimes tends to obscure the ridges. The species is two-brooded; moths of the first brood emerging from larvae feeding in June and early July; a second brood overwinters in the pupal state.

Three of the March specimens (from Clarkston, Washington) differ from the type series and the other specimens of a summer brood in the almost white ground color, the white marks defined only by absence of any dark dusting.

Apart from characters of the genitalia, the dark longitudinal streak on the eye-caps is perhaps the best distinguishing character; it is present and conspicuous in all specimens examined and may serve to confirm identification of flown specimens of this very variable species.

(48) **Bucculatrix illecebrosa** new species (Figs. 10, 140, 140a, 141.)

Face gray, tuft with dark brown and bright ochereous-brown hairs; eye-caps white, finely speckled with dark brown, antennal stalk pale grayish, annulate with blackish brown, the annulations narrow and closely placed toward base. Thorax bright brown. Fore wing (fig. 10) predominately bright brown, the scales below the fold black-tipped; at one-third of costa, black-tipped scales form the inner margin of an oblique white streak, broad on costa, but dusted with black specks in the outer part on costa; beyond middle of wing, a second oblique costal streak, also margined inwardly by black-tipped scales, attains the middle of the disc and is here acutely angled (this angle not always distinctly defined); apical area of wing white, speckled with black-tipped scales, a black apical spot usually distinct; a line of black-tipped scales around apex continues less distinctly toward tornus; the black-tipped scales form a dark shade below fold, and margin an oblique white streak which is divided by a line of black-tipped scales; beyond this white streak, black scales are massed to form a rather conspicuous black patch below fold, and inwardly border a second oblique white streak; cilia pale gray. Hind wings and cilia gray. Legs fuscous, tarsal segments black-tipped. Abdomen dark gray above, silvery gray beneath.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 140, 140a). Harpe typical of the group, abruptly tapering near apex, setal arrangement as in *divisa*; socii broadly triangular, setose; subscaphium an elongate dorso-ventral plate; anellus conical; aedeagus long, sinuate, slender throughout its length; vinculum with a broad anterior sinus. Scale sac present.

Female genitalia (fig. 141). Segment 9 modified, rasping rods feebly developed; vaginal setae very minute, notched at tips; on segment 8, a large tuft of specialized scales each side of ostium, and near lateral line a small triangular sclerotized plate; ostium in a depression at anterior margin of segment 8, two diverging posterior sculptured bands; posterior dorsal margin of segment 8 bilobed; ductus bursae sclerotized into segment 6 and bent to the right; signum ribs with very long slender spines.

Type.—♂, Colfax, Placer County, California, "wild sunflower," iss. VII.5 (A. H. Vachell) [U.S.N.M., Type No. 65026].

Allotype.—♀, same data as the type.

Paratypes.—4 ♂, 5 ♀, same data as the type; 1 ♂, Shasta Retreat, Siskiyou County, California, June 16–23 [U.S.N.M.].

Food plant as given on the locality labels is "wild sunflower." The larvae are leaf-skeletonizers, as shown by fragments of leaves accompanying the specimens. Cocoon white or pale yellow, with ten or eleven sharp ridges.

There is unusual constancy of wing markings; the configuration of markings however suggests relationship to *B. divisa*, from which it is amply differentiated by characters of the genitalia, especially of the female, by the different larval feeding habits, and by the fewer ridges of the cocoon.

(49) ***Bucculatrix insolita*** Braun (Figs. 143, 143a, 144, 144a.)

1918. *Bucculatrix insolita* Braun, Ent. News XXIX: 248. Type ♂, allotype ♀, San Bernardino Mountains, California [A.F.B.Coll.].

Face gray, tuft of whitish and dark gray or brown scales intermingled; eye-caps whitish, antennal stalk black. Thorax and basal third of fore wings white to a line extending obliquely outward from costa to dorsum; a stripe of black scales along costa from base nearly to one-third; some blackish scales near base of dorsum; sometimes a large patch of grayish ocherous dark-tipped scales lying over the fold; middle third of wing occupied by a broad truncated blackish triangle, its broad base on costa, with a few whitish scales on costa near its inner side; white oblique curved streaks border the black area outwardly and meet at an angle in the middle of the wing, the white prolonged from the angle toward termen and almost connected with an irregular patch of white scales on costa before apex; space between this white patch and the curved white costal streak dusted with grayish or ocherous black-tipped scales; a black spot at apex, and a line of black-tipped white scales around apex in the dark gray cilia. Hind wings and cilia irrorated fuscous. Legs black, bases of tarsal segments white. Abdomen blackish, with silvery gray anal tuft.

Alar expanse 7 to 7.5 mm.

Male genitalia (figs. 143, 143a). Harpe typical of the group, slender in its apical half, with a few very heavy setae at apex, and several scattered such setae before apex; tegumen bulging before the rounded setose socii; subscaphium a thin dorso-ventral plate; anellus a broad cone; aedeagus long, sinuate, near tip an elongate internal thickening lobed at base (fig. 143a); vinculum with broad anterior sinus. Scale sac small, its diameter less than half the length of segment 2.

Female genitalia (figs. 144, 144a). Segment 9 modified, rasping rods well developed, vaginal setae notched at tip; on segment 8, a large tuft of specialized scales each side of ostium, and near lateral line a small clear circular spot; ostium in a depression at anterior margin of 8, two diverging posterior furrows, sculptured and microscopically spinulose at their margins; ductus bursae strongly sclerotized in segment 7 and bent to the right; signum ribs closely placed, spines long posteriorly, short and irregular anteriorly (fig. 144a).

Specimens examined.—1 ♂, 2 ♀.

CALIFORNIA: San Bernardino Mountains, ♂ type, Camp Baldy, July 7, 1914, with note "beaten from fir"; Fredalba, ♀ allotype, August 29, 1912, ♀ paratype, August 30, 1912 (G. R. Pilate) [A.F.B.Coll.].

Food plant and early stages unknown.

The sharp contrast between the almost white basal third of the fore wing and the dark middle section makes this one of our most easily recognized species.

(50) ***Bucculatrix transversata*** Braun (Figs. 142, 142a.)

1910. *Bucculatrix transversata* Braun, Ent. News XXI: 177. Type ♂, Rivera, Los Angeles County, California [A.F.B.Coll.].

Face white, gray- and brown-speckled; tuft brown, darkest in the center, a few white hairs in front and at the sides; eye-caps very small, white; antennal stalk gray with dark brown annulations. Thorax dark brown in center, shading to bright brown laterally. Fore wings bright brown, except along the wing margins where the scales are white with black tips from middle of costa, around apex, along termen and nearly to middle of dorsum; near middle of costa, a faint paler spot; just before apex on costa, the white border enlarges into a triangular undusted spot; on middle of dorsum a narrow half-crescent of black raised scales, bordered inwardly by a pale shade, and followed by a few scattered black scales; a straight transverse line of conspicuous black-tipped scales crosses the gray apical cilia. Hind wings and cilia gray. Legs gray, tarsal segments narrowly black-tipped. Abdomen shining gray, paler beneath.

Alar expanse 7 mm.

Male genitalia (figs. 142, 142a). Harpe typical of the group, abruptly narrowing near apex, setae strong, closely placed on the apical area; socii setose,

their tips curved ventrad; subscaphium an elongate narrow strip; anellus conical; aedeagus sinuate, abruptly contracting beyond middle, slightly flared at tip; vesica with two ill-defined teeth near tip; vinculum narrow, with a shallow scarcely perceptible anterior sinus. Scales of scale sac elongate.

Specimen examined.—1 ♂.

CALIFORNIA: Rivera, Los Angeles County, ♂ type, rearing record B.588, larva on leaves of *Ambrosia psyllostachya* DC., imago December 5, 1909 [A.F.B.Coll.].

Only the male type is known.

The larva feeds in October on the upper side of the leaf, consuming irregular patches of leaf tissue; pupation takes place in the latter part of that month.

The rather uniform brown color of the fore wings, with white black-dusted margins, and the transverse black apical line characterize this species.

(51) ***Bucculatrix koebelella*** Busck

(Figs. 145, 146.)

1909. *Bucculatrix koebelella* Busck, Proc. Ent. Soc. Wash. XI: 184. Types, ♂, ♀, on same mount, Los Angeles County, California [U.S.N.M., Type No. 12692].

Face white, with some minute fuscous dusting; tuft of mingled white and ochereous-fuscous hairs; eye-caps whitish with fuscous dusting; each segment of antennal stalk shading from grayish white through ochereous-fuscous to black. Thorax white, densely dusted with fuscous. The white or sometimes pale grayish ochereous ground color of the fore wings largely obscured by ochereous-fuscous scales; markings blackish; the only white or nearly white area of the wing is a wedge-shaped streak from base to one-third, lying between the fuscous costa and a blackish streak from base along fold; an oblique fuscous costal streak at one-third, a second less distinct costal streak beyond middle ends in a small longitudinal black spot at end of cell; the blackish streak from base in fold is followed on the fold by a patch of a few black raised scales; this is followed by a second blackish streak in fold; a greater or less concentration of blackish scales in the apex, sometimes produced basad to the black spot at end of cell; cilia pale grayish ochereous, with a line of black-tipped scales from apex toward tornus. Hind wings pale silvery fuscous, cilia faintly ochereous tinged. Legs pale fuscous, with more or less distinctly black-tipped tarsal segments. Abdomen pale silvery fuscous above, whitish beneath.

Alar expanse 8 mm.

Male genitalia (fig. 146). Harpe typical of the group, abruptly narrowing near apex, with heavy setae on the apical narrow area; socii pointed, incurved, setose; subscaphium minutely spinulose; anellus asymmetric, sclerotized, aperture to the right and below apex; aedeagus long, broad at base and gradually tapering to the semicircular curved apex, aperture before apex, just basad of the semicircle; vinculum narrow, retuse. Scale sac present.

Female genitalia (fig. 145). Segment 9 modified, rasping rods well developed, vaginal setae conspicuous within the vagina, apices rounded, notched; on segment 8, on each side of ostium, a depressed nearly circular area, its surface closely beset with microscopic blunt teeth, its inner margin curving and thence directed posteriorly, forming the upper edge of an erect sclerotized arc-shaped plate; ductus bursae sclerotized in segment 7, with a sac-like production at the junction with the membranous section; signum an obliquely placed ellipse, open dorsally, ribs with evenly spaced long spines.

Specimens examined.—43, representing both sexes.

CALIFORNIA: Los Angeles County, ♂, ♀, types (on same mount), "on *Artemisia californica*," March (A. Koebele) [U.S.N.M.], 18 "cotypes," seven of these labeled "on *Artemisia californica*," March (A. Koebele) [U.S.N.M.]; 2 ♀, ex type series [A.F.B.Coll.]; Fredalva, 11, ♂, ♀, August 29 to Sept. 2 (G. R. Pilate); Camp Baldy, San Bernardino Mountains, 1 ♂, July 29 (G. R. Pilate); Alameda County, 9, ♂, ♀, April 12 (G. R. Pilate) [A.F.B.Coll.].

The dates of collection indicate two generations a year.

This apparently common species may be recognized by the general grayish aspect, and by the white wedge-shaped streak from base lying between the fold and the fuscous stripe along costa. The depressed circular area and the erect arc-shaped plate arising from it on segment 8 of the female abdomen separate it from all other species except *salutatoria* Braun, which is however amply differentiated from *koebelella* on other characters.

(52) ***Bucculatrix salutatoria*** Braun (Figs. 12, 51, 51a, 149, 150, 150a, 151.)

1925. *Bucculatrix salutatoria* Braun, Trans. Amer. Ent. Soc. LI: 221. Type ♂, head of Swan Creek, Rich County, Utah [A.F.B.Coll.].

1958. *Bucculatrix salutatoria* Braun, Trans. Amer. Ent. Soc. LXXXIV: 106.

Face white, tuft of mingled white, dull ochereous and gray hairs; eye-caps white, antennal stalk annulate with gray. Thorax white. Fore wing (fig. 12) white, finely dusted with pale dull ochereous scales, which are usually darker tipped; basal area between costa and fold usually but little dusted; scales, more deeply dark-tipped, are grouped to form indistinct darker markings, separated by white scales; a narrow oblique streak from basal third of costa, a second broader oblique streak ending in a black dot (sometimes almost absent) in the middle of the wing; below the middle of the wing both of these streaks blend into the general dusted ground color; a patch of dark-tipped scales, with more of the ochereous color, occupies the apical third of the wing, in its costal half tending to divide into several more or less distinct transverse lines, white scales on costa precede an irregular black spot at apex; a small patch of black raised scales in the middle of the wing below fold, sometimes extended to dorsum by

dark scales, forming a half crescent, which may be margined with white scales; a similar patch of raised scales on termen; cilia gray, with a line of minutely black-tipped scales from apex toward tornus, sometimes connected with the apical spot, and a second conspicuous, and in perfect specimens sinuate line of black-tipped scales extending through the outer third of the cilia along termen. Hind wings and cilia lustrous, grayish white, with a coppery tinge. Prothoracic legs black, meso- and metathoracic legs banded with black and white, tarsal segments black-tipped. Abdomen fuscous-ocherous, with ocherous anal tuft.

Alar expanse 8 to 9.5 mm.

Male genitalia (fig. 149). Harpe typical of the group, broad, abruptly contracting to the small apical lobe (cucullus) bearing short heavy setae, free costal arms larger than in allied species and more strongly sclerotized; socii small, elongate, rounded at tip; subscaphium a thin dorso-ventral plate; anellus asymmetric, aperture to left below tip; aedeagus long, gradually tapering to near apex, then abruptly contracting to the slender curled apical section; vinculum a narrow ring, slightly retuse. Scale sac minute, scales few.

Female genitalia (figs. 150, 150a, 151). Segment 9 modified, rasping rods well-developed; vaginal setae broad, asymmetric, the larger bilobed (fig. 151); on each side of ostium, a rounded depressed area, its inner margin curving posteriorly and rising to form the upper edge of a sclerotized erect plate, its outer margin meeting the middle of the base of this erect plate at an acute angle, the whole beset with microscopic teeth, those of the erect plate slender and acute; ostium wide, a short sclerotized section of ductus bursae broad funnel-shaped, membranous portion of ductus short, slender, curving to the right, then left, then extending anteriorly to the very large bursa copulatrix, which extends into segment 1; signum in segments 5 and 6, a ring broken dorsally, spines long and slender (fig. 150a).

Specimens examined.—41, representing both sexes.

UTAH: Swan Creek, Rich County, ♂ type, 1 ♂, 1 ♀ paratype, June 29, 1924 (A. F. Braun) [A.F.B.Coll.].

COLORADO: Grand Lake, 1 ♂, August 7, 1929 (A. F. Braun) [A.F.B.Coll.].

WYOMING: Grand Teton National Park, 1 ♂, 3 ♀, rearing record B.2290, on *Artemisia tridentata* Nutt., imagoes July 11, July 15, 1959 (A. F. Braun) [U.S.N.M. and A.F.B.Coll.].

BRITISH COLUMBIA: Seton Lake, Lillooet, 13, ♂, ♀, May 30, 1926 (J. McDunnough) [C.N.Coll.]; Hedley, 5800 feet, 19, ♂, ♀, July 31, August 1, 1934 (A. N. Gartrell) [C.N.Coll.]; Peachland, 1 ♀, June 27, 1935 (A. N. Gartrell) [C.N.Coll.].

The larvae are miners in leaves of sagebrush (*Artemisia tridentata* Nutt.). The first very narrow linear mine lies along the margin of the leaf, and except for the frass contained therein, soon becomes scarcely discernible. On leaving this mine, the larva forms small narrow mines

along the margin of the leaf, entering the leaf on the upper side at or near the margin (fig. 51); the entrance hole sometimes appears as a notch in the leaf margin as the epidermis shrivels; all frass is voided outside these mines. The cocoons are spun on the underside of a leaf; they are rather broad and stout, the eight to ten fine sharp white anastomosing ridges stand out conspicuously against the otherwise pale gray color (fig. 51a). Cocoons collected July 4 on a moraine slope of the Taggart Lake trail, Grand Teton National Park, yielded moths July 11 and July 15. One of the Lillooet, B. C. specimens bears the notation "Host Sagebrush."

Bucculatrix saluatoria occurs in less xeric and more northern habitats than the more common *B. tridenticola* new species, also on sagebrush; it may be sought for in a community transitional between sagebrush and forest. The cocoon of *B. saluatoria* may be distinguished from that of *tridenticola* by its broader form, and the fewer and anastomosing ridges. The imagoes of the two species, if collected together, are easily separated by color and wing markings.

(53) ***Bucculatrix leptalea*** new species

(Figs. 14, 147, 147a, 148, 148a, 148b, 148c.)

Face white, tuft white, centrally with a few pale gray hairs; eye-caps white, very small, antennal stalk gray, faintly annulate. Fore wing (fig. 14) white with pale ochreous marks, in which some of the scales may be darker-tipped, and two blackish dots. Sometimes a faint ochreous suffusion along fold from base, and sometimes a similar faint suffusion below costa at about one-third; at two-thirds of costa, an oblique pale ochreous streak in which the scales are minutely darker-tipped; near apex on costa a more or less distinct patch of such scales, and opposite it, a similar patch of scales, usually less defined; just beyond middle of fold, a group of a few black scales (sometimes absent) followed by pale ochreous, minutely darker-tipped scales; on the disc, a black dot, often more distinct than the one in the fold, is farther from the black spot in fold than it is from a few black-tipped scales at apex; scattered black-tipped scales in the cilia of termen. Hind wings and cilia white, with a faint ochreous tinge toward apex. Legs white, tarsal segments pale gray-tipped. Abdomen with ochreous and fuscous shading.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 148, 148a, 148b, 148c). Harpe typical of the group, broad at base tapering to apex, setae short, heavy at apex; socii broad, widely separated, each terminating in a small pointed setose lobe, and bearing on the ventral surface a narrow elongate lobe, setose along its free margin (fig. 148a); subscaphium a narrow spinulose ridge; anellus conical, asymmetric, aperture to

the right; aedeagus tapering, curled at apex; vinculum with a slight anterior sinus; scale sac (fig. 148c) small, scales slender.

Female genitalia (figs. 147, 147a). Segment 9 not greatly modified, rasping rods weak, vaginal setae very minute and slender; on each side of the wide ostium, a minutely spinulose band; near lateral margin of 8, a tuft of specialized scales; on dorsal surface of 8, a pair of circular depressed minutely spinulose areas, indistinctly connected by a sclerotized line; at the anterior margin of the intersegmental membrane, a row of slender specialized scales, overlain and hidden by the normal scales of the margin of the sclerotized anterior half of segment 7; a sclerotized section of the ductus bursae curves abruptly to the right; signum a ring very obliquely (almost longitudinally) placed, signum ribs (fig. 147a) with abruptly tapering strong spines.

Type.—♂, Snake River, opposite Clarkston, Washington, March 6, 1931, "reared from *Artemisia dracunculus*," (J. F. Gates Clarke) [U.S.N.M., Type No. 65027].

Allotype.—♀, same data as the type.

Paratypes.—2 ♂, 6 ♀, same data as the type, except dates of emergence from March 2 to March 19 (J. F. Gates Clarke) [U.S.N.M. and A.F.B.Coll.]; 1 ♂, Wilma, Whitman County, Washington, March 27, 1934, "reared from *Artemisia dracunculoides*" (J. F. Gates Clarke) [U.S.N.M.]; 4 ♂, Aweme (southwest of Brandon), Manitoba, May 27, 1921 (N. Criddle) [C.N.Coll.]; 1 ♂, Loma Linda, San Bernardino County, California, June 1, 1912 (G. R. Pilate) [A.F.B.Coll.].

The food plant, recorded on the specimen labels as *Artemisia dracunculus* or *Artemisia dracunculoides*, is listed under several names in the various manuals—in Gleason (1952) as *Artemisia dracunculus* L., with *dracunculoides* Pursh and *glauca* Pall. as synonyms; in Fernald (1950) as *glauca* (including *A. dracunculoides* and *A. Dracunculus*, subsp. *glauca*), and in older Gray's Manual (7th edition) as *dracunculoides*.

The narrow ventral lobe of socius, fringed with setae, separates this species on genitalic characters from all American species. By genitalia, *B. leptalea* is very closely allied to the European *B. artemisiae* H.-S.; the female genitalia are quite similar, but the dorsal circular areas of segment 8, are, in *B. artemisiae*, scaled, not merely minutely spinulose as in *B. leptalea*; the figure of the male of *B. artemisiae* in "The Genitalia of the Tineina" by Pierce and Metcalfe shows a ventral lobe similar to that of *B. leptalea*, but such a lobe is not present on a slide of the male genitalia made from a European specimen from the Hofmann

Collection in the United States National Museum. By markings the two species would not be confused.

In wing markings, *B. leptalea* can scarcely be distinguished from *B. seorsa* new species on *Artemisia tridentata* from California; the slight differences in wing markings are noted under the latter species.

(54) ***Bucculatrix arnicella*** Braun (Figs. 50, 152, 153.)

1925. *Bucculatrix arnicella* Braun, Trans. Amer. Ent. Soc. LI: 223. Type ♀, Logan Canyon, Utah [A.F.B.Coll.].

Face pale gray, sometimes minutely darker gray speckled; tuft dark gray and white, usually white below, and in paler specimens, the white predominating laterally; eye-caps speckled dark gray, except the projecting scales of the anterior edge which are white and separated from the speckled portion by a line of black scales; antennal stalk gray with black annulations. Thorax and fore wings so densely speckled with black-tipped and black scales (fading to brownish with age) as to give the wing an irrorated dark gray aspect with blacker areas. Areas with more narrowly dark-tipped scales may appear as pale patches and streaks; such a patch on middle of costa may continue as an oblique streak; a second oblique whitish streak extends toward termen which it sometimes reaches; on middle of dorsum, a more or less quadrate patch of black scales, margined on its inner and sometimes upper side by black-tipped white scales, and outwardly by an oblique streak of such scales which sometimes meets the second costal streak at an acute angle; scales at apex black-tipped or sometimes wholly black, thus forming a black apical dot, above which there may be a group of pure white scales; a marginal line of black-tipped scales from costa around apex is sometimes connected with the black apical dot by two or three black scales; a distinct and rather conspicuous line of black-tipped scales around apex in the dark gray cilia. Hind wings and cilia gray, the depth of color varying with the amount of black in the fore wings. Legs gray, with black-tipped tarsal segments. Abdomen dark gray above, silvery gray beneath.

Alar expanse 8 mm.

Male genitalia (fig. 152). Harpe typical of the group, costal margin bulging slightly before apex, which bears short heavy setae; socii broad, curving toward midline, setose; subscaphium minutely spinulose; anellus tapering to a slender tip; aedeagus long, gradually tapering, curved at apex; vinculum with a deep anterior sinus. Scale sac of moderate size, oval.

Female genitalia (fig. 153). Segment 9 modified, rasping rods well-developed, but not strongly sclerotized, vaginal setae minute, indistinctly notched at tips; on segment 8, diverging obliquely from each side of ostium, a sculptured depressed band; on each side of ostium nearer the lateral margin, but attached at the posterior margin of the intersegmental membrane, a fan-shaped group of long specialized scales, closely appressed and curving toward mid-ventral line;

ostium in a round depression; a sclerotized section of ductus bursae bending to the right and extending into the sixth segment is followed by a short membranous section; signum a complete ring lying almost longitudinally, with ribs of equal length except a few short irregularly-spined dorsal ribs.

Specimens examined.—3 ♂, 3 ♀.

UTAH: Logan Canyon, near Logan, ♀ type, ♂ paratype, rearing record B.1169, larvae mining leaves of *Arnica cordifolia* Hook., imagoes July 3, 1924 [A.F.B.Coll.].

WYOMING: Grand Teton National Park, Taggart Lake trail, 2 ♂, 2 ♀, rearing record B.2289, on *Arnica cordifolia* Hook., imagoes July 21, 24, 26, 1959 (A. F. Braun) [A.F.B.Coll.].

The name *arnicella* is hereby restricted to the female type and one male paratype reared on *Arnica cordifolia*, and to specimens reared on that food plant. The two specimens emerging from cocoons collected on sagebrush, and cited as paratypes in the original description of *arnicella*, do not represent that species and are included among the paratypes of the following species.

The rather long linear mine, very indistinct at first in its somewhat winding course on the leaf blade, later follows the leaf margin; it is most conspicuous on the upper side of the leaf. Upon leaving this first mine, the larva mines into the leaf from the underside making a number of successively larger, but small Coleophora-like mines; one leaf may contain 13 or 14 such mines, varying in diameter from about 1.5 mm. to 4 mm., the work of a single larva. The feeding larva is green, the full-fed (spinning) larva reddish with darker red longitudinal stripes. The rather slender cocoons vary in color from whitish, to yellowish, to a decided pink; the ridges are often obsolete, but when present number from seven to nine (fig. 50), that is they are much fewer in number than in the very similar species on sagebrush.

Bucculatrix arnicella is a forest species and should be sought on its food plant in open lodgepole pine and Douglas fir forest. In addition to the localities from which moths were reared, the work of the larvae has been observed in similar situations in Glacier National Park, Montana, and Waterton Lakes National Park, Alberta.

Superficially, *arnicella* is scarcely differentiated from the following species; in genitalia it is abundantly distinct. Characters separating the two species are enumerated under the following species.

(55) *Bucculatrix tridenticola* new species

(Figs. 49, 154, 154a, 155, 156, 156a.)

1925. *Bucculatrix arnicella* Braun (not Braun), Trans. Amer. Ent. Soc. LI: 223. One male, one female listed as paratypes of *arnicella* in the description of that species, are here excluded from *arnicella*.

Face white, finely gray speckled; tuft white in front, chiefly gray above, sometimes with a slight admixture of white hairs; eye-caps white in the anterior half, densely black-speckled in the posterior half, antennal stalk annulate with alternate black and pale gray or white rings, thus more conspicuously annulate than in *arnicella*. Fore wings densely speckled with black-tipped gray scales; more or less defined white or lightly dusted areas constitute the costal and dorsal streaks; a gradually widening narrow wedge-shaped black streak from base along fold to the white inner margin of a quadrate or half-crescent-shaped black mark on the middle of dorsum in which there are a few raised scales; the wing between the black streak in fold and the dorsum is usually somewhat paler than the general ground color, and when the wings are folded with dorsal margins meeting, this area forms, with the white inner margin of the dorsal black spot, an hour-glass-shaped mark, with the constriction near the white margin; from the base of wing, contiguous to the black streak in fold is a very short dash of elongate white scales which is usually, except in the darkest specimens, easily discernible and constitutes a recognition character for the species; from before middle of costa a pale or whitish streak (rarely conspicuous) with a line of black scales along its inner margin; at two-thirds of costa a more conspicuous and larger white or little dusted streak, less oblique than the corresponding streak in *arnicella*, which may meet, at an obtuse angle, the outer white streak margining the black dorsal spot or be separated from it by a line of black scales; apical area, especially in the costal half, mostly white, with a small black apical dot, below which the white scales are narrowly black-tipped; a conspicuous line of black-tipped scales extends from the white costal cilia around apex in the pale gray cilia. Hind wings and cilia dark gray. Legs gray, tarsal segments black-tipped. Abdomen dark gray above, silvery gray beneath.

Alar expanse 7.5 mm.

Male genitalia (figs. 154, 154a, 155). Harpe typical of the group, *socii* rounded, incurved, with heavy setae similar to those on the harpe; tegumen below *socii* swollen, forming two setose lobes (? gnathos); subscaphium minutely spinulose; anellus conical; aedeagus nearly as long as the body, sinuate, slender in its outer two-thirds; vinculum narrow. Scale sac very small.

Female genitalia (figs. 156, 156a). Segment 9 modified, rasping rods strong, vaginal setae comparatively large, the larger ones may be three-lobed at tip; posterior to ostium on membrane of 8, an area of minute forked spinules; larger areas of similar spinules lateral to ostium; on each side at the posterior lateral margin of the intersegmental membrane, a fan-shaped group of long specialized scales curving toward the mid-ventral line; on the intersegmental membrane

and lying beneath the overlying segment 7, a compact patch of dark-pigmented specialized scales in a circular slightly depressed pocket; ostium in a rounded depression at the anterior margin of segment 8; ductus bursae sclerotized nearly to the anterior margin of segment 5; a short membranous section abruptly curves to the left and enters the bursa copulatrix dorsally; spines of signum ribs graduating from long slender acute to short.

Type.—♂, Spring Creek, Baker County, Oregon, July 18, 1955 (J. F. G. Clarke); genitalia slide 10505, J. F. G. C. [U.S.N.M., Type No. 65028].

Allotype.—♀, same data as the type [U.S.N.M.].

Paratypes.—25, ♂, ♀, same data as the type [U.S.N.M.]; 1 ♂, 2 ♀, French Glen, Harney County, Oregon, July 14, 1953, "reared from *Artemisia tridentata*," "on twigs of sagebrush," (F. P. Larson) [U.S.N.M.]; 1 ♂, Pullman, Washington, September 20, 1930 (J. F. G. Clarke) [A.F.B.Coll.]; 1 ♀, Toppanish, Washington, May 31, 1946 (B. J. Landis) [U.S.N.M.]; 1 ♂, 2 ♀, Entiat, Washington, June 10, 1914 (E. J. Newcomer) [U.S.N.M.]; 6, ♂, ♀, Ephraim, Utah, June 18, 1943, "sagebrush" (G. F. Knowlton) [U.S.N.M.]; 1 ♂, 1 ♀, Logan, Cache County, Utah, rearing record B.1152, from cocoons on leaves of *Artemisia tridentata*, imagoes June 29 and July 1, 1924 (A. F. Braun) [A.F.B.Coll.]; 15, ♂, ♀, Reno, Nevada, bearing March and October dates (H. G. Dyar) [U.S.N.M.]; 1 ♀, Boulder, Colorado, March 23, 1907 (T. D. A. Cockerell) [U.S.N.M.]; 1 ♀, Florissant, Colorado, June 28 (Cockerell) [U.S.N.M.]; 1 ♂, Aweme (southwest of Brandon), Manitoba, 23 June, 1912 (N. Criddle) [C.N.Coll.].

Food plant, *Artemisia tridentata* Nutt. No details of the early stages are known; a small linear mine observed on the leaves at the time the cocoons of the Logan, Utah specimens were collected may belong to this species. The small whitish cocoon (fig. 49), marked with twelve or thirteen fine ridges, of which ten or eleven are usually distinct, is spun on the underside of leaves or on twigs of the food plant.

B. tridenticola is a common species of the sagebrush association, occurring in more xeric habitats than *B. saluatoria*, also a sagebrush feeder.

The moths closely resemble *B. arnicella*, and may easily be confused with that species without data on habitat and food plants. Perfect specimens of *tridenticola* may be separated from *arnicella* by the minute white dash at base of fore wing, the black streak in fold, and by the angle of meeting of the second costal pale streak and the corresponding dorsal streak—obtuse in *tridenticola*, acute in *arnicella*. On genitalic characters of both sexes the two species will not be confused. The very long curved aedeagus, one-third longer than that of *arnicella*, is a character visible in the dry insect.

(56) *Bucculatrix spectabilis* new species

(Fig. 157.)

Face dull white, tuft of mingled white and gray hairs, the gray predominating above; eye-caps white, antennal stalk gray, segments shading to whitish at bases. Thorax white, gray-speckled, tegulae dark gray anteriorly. Ground color of the fore wings dull white, the basal half sparsely dusted with black-tipped brownish scales, these scales concentrated along edge of costa and along dorsum near base; before middle of costa, a small oblique streak of black-tipped brown scales; beyond middle, a broad patch of such black-tipped scales, bending in the middle of the wing, thence extending to termen above tornus; this patch is margined outwardly by a line of black scales which bends at a sharply defined obtuse angle in the middle of the wing; the costal half of this black line is followed by an erect white costal spot; on dorsum, an elongate oval dark patch, half of it lying above the fold, reaches nearly to tornus and is followed at tornus by a whitish spot, lying a little basad of the white costal spot; apical area heavily dark dusted, the blackish apical spot encircled by white or lightly dusted scales; a line of black-tipped scales through the middle of the white cilia from opposite apex almost to the gray cilia at tornus. Hind wings and cilia gray. Legs gray, tibial hairs of the hind pair whitish, tarsal segments whitish, gray-tipped. Metathorax with a large black spot each side of midline; abdomen dark fuscous, anal scales paler.

Alar expanse 7.5 mm.

Female genitalia (fig. 157). Ovipositor modified, rasping rods strong, vaginal setae large, elongate, midway with a single basally directed point; lateral anterior margins of segment 8 prolonged, simulating anterior apophyses; on tergite of segment 8, a large fan of specialized scales on each side of mid-line, the longer lateral scales reaching nearly to tip of ovipositor, beneath these scales and toward mid-line, areas of broad-based microscopic spinules; on sternite of 8, latero-posterior fans of specialized scales, and anterior to these, patches of broad-based spinules, bordered anteriorly by a sinuate sclerotized line; a narrow transverse plate at posterior ventral margin of sclerotized anterior half of segment 8; on intersegmental membrane laterally, depressed pockets of small dark-pigmented specialized scales; ostium at the anterior margin of the broadly produced segment 8, circular, its margins sclerotized, abruptly contracting to the slender ductus bursae, which bends to the right and is sclerotized through segment 7; inception of ductus seminalis in segment 6, adjacent to the sclerotized section; bursa copulatrix in the anterior end of abdomen, signum a ring of closely placed spined ribs.

Type.—♀, Madera Canyon, 4880 feet, Santa Rita Mountains, Arizona, 29 August, 1959 (R. W. Hodges) [Cornell U., Type No. 3644].

Paratype.—♀, same data as the type, except date, August 1 (R. W. Hodges) [Cornell U.].

Food plant and early stages unknown.

Both by general aspect and genitalia, *B. spectabilis* is most nearly related to *B. tridenticola* new species. The peculiar shape of the vaginal setae is diagnostic.

(57) ***Bucculatrix seorsa*** new species

(Figs. 158, 159, 159a.)

Face white, tuft white or faintly ochereous, eye-caps white, antennal stalk with conspicuous black annulations. Thorax white, with a few minutely dark-tipped scales. Fore wings white, with two black dots and aggregations of minutely dark-tipped pale ochereous scales; scarcely perceptible groups of such scales near base of costa, in the basal half of fold, and below fold near base; before middle of costa a small group of such scales; beyond middle of costa a larger diffuse patch of ochereous dark-tipped scales, which may be indistinctly connected with a black spot on the disc, this spot may be a minute dot or may be composed of a number of scales and is then more or less elongate; immediately below middle of fold, a few raised scales form a small black dot followed by pale ochereous dark-tipped scales extending from above fold to dorsum; this black dot, the discal spot, and the black-tipped scales at apex are about equally spaced (cf. *B. leptalea*); just before apex the pale dark-tipped scales form opposite groups, leaving the apex of the wing white; from the extreme apex a few black-tipped scales project into the cilia, and may form a broken line along termen; a second short line of black-tipped scales at apex beyond middle of the white cilia. Hind wings white, faintly ochereous tinged. Legs white, pro- and mesothoracic tarsal segments black-tipped, metathoracic brown-tipped.

Alar expanse 7 mm.

Male genitalia (figs. 159, 159a). Harpe broad, costal margin abruptly curving to a small apical lobe (cucullus), bearing short conical setae; tegumen incurved, the socii arising from the incurved edges of tegumen, and thus directed ventrad; uncus present, a minute curved setose hook; anellus a cone; aedeagus wide in basal half, abruptly narrowing to the curving outer half; vinculum a narrow band. Scale sac pear-shaped.

Female genitalia (fig. 158). Segment 9 modified, rasping rods well-developed and strongly sclerotized; vaginal setae relatively large, bilobed or with up to four or rarely five or more teeth; near each lateral margin of sternite of 8, a narrow raised plate, marked with oblique ridges, and lateral to these, areas of closely placed low rounded elevations; near posterior margin of tergite of 8, two groups of slender hair-like scales; on intersegmental membrane laterally, oval slightly depressed pockets bearing groups of short specialized scales; ostium at the anteriorly produced margin of segment 8; a short wide sclerotized section of ductus bursae bending to the right is followed by a short membranous section; signum ribs narrow, spines very long and slender.

Type.—♀, Wendel, Lassen County, California, on *Artemisia tridentata* Nutt., June 15, 1951 (H. H. Keifer) [U.S.N.M., Type No. 65029].

Allotype.—♂, same data as the type [U.S.N.M.].

Paratype.—♀, Seton Lake, Lillooet, British Columbia, May 30, 1926 (J. McDunnough) [C.N.Coll.].

No details of the early stages are known.

In wing markings and general aspect, *B. seorsa* is almost indistinguishable from *B. leptalea*. The group of scales at one-third of costa in *B. seorsa*, suggesting an oblique streak, is represented by a faint ochereous suffusion below costa in *B. leptalea*; the relative positions of the black plical dot, the discal dot, and the black scales at apex may aid in separation of the two species. The only certain means of separation are the very different genitalia of these two species (compare figures 148 and 159, and figures 147 and 158). Female genitalia indicate close relationship to *B. angustisquamella*; the short, wide sclerotized section of the ductus bursae and the narrow raised plate on segment 8 (sometimes obscured on the slide) separate *seorsa* from *angustisquamella*.

(58) ***Bucculatrix angustisquamella*** Braun (Figs. 160, 160a, 161, 161a.)

1925. *Bucculatrix angustisquamella* Braun, Trans. Amer. Ent. Soc. LI: 220.

Type ♀, Logan Canyon, near Logan, Utah [A.F.B.Coll.].

1958. *Bucculatrix angustisquamella* Braun, Trans. Amer. Ent. Soc. LXXXIV: 107.

Face white, tuft of mingled white and gray hairs; eye-caps white, minutely gray speckled, each segment of the stalk shading from white through pale gray to dark gray. Thorax white, finely gray dusted. Fore wings white, scales, especially toward apex, narrow; brown- or black-tipped scales are grouped into ill-defined markings, with a scattering of minutely brown-tipped scales; a few minutely brown-tipped scales along costa from base, a more distinct streak in fold near base, and some brown-tipped scales along basal third of dorsum; from just before middle of costa, a narrow oblique streak of dark-tipped scales, which may meet the upper edge of a larger patch of dark-tipped scales on middle of dorsum, bearing a group of black raised scales toward its inner edge below fold; a second, broader and less oblique costal streak, is marked at the end of the cell by two or three darker scales, and is connected at its inner side with the dorsal patch and outwardly meets an irregular transverse band of dark-tipped scales; on the outer side of this transverse band below apex is a group of blackish raised scales; dark scales at apex may form an apical spot, but usually appear scattered at apex and along termen; a line of dark scales through the middle of

the cilia. Hind wings grayish white, cilia pale gray with ocherous bases. Legs grayish white, tarsal segments dark gray-tipped.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 161, 161a). Harpes typical of the group, tapering, slender beyond middle, apex with short heavy setae; tegumen long, exceeding the harpes, socii small, setose; uncus present, a slender, sharp, setose hook; anellus a slender, obliquely truncate cone; aedeagus long, slender, tapering, aperture before the slender curving apical section; vinculum a slightly retuse band. Scale sac (fig. 161a) very small.

Female genitalia (figs. 160, 160a). Segment 9 modified, rasping rods strongly sclerotized, vaginal setae in lateral and median groups, convex with sharp apical teeth, the larger with seven or eight teeth; segment 8 laterally finely reticulate (fig. 160a); on the intersegmental membrane lateral to ostium, a depressed transversely elongate group of short specialized scales; ostium in a slight depression, ductus bursae sclerotized into segment 6, bending to the right and tapering to the slender membranous section; signum a ring, ribs narrow, spines long and slender, the dorsal ribs with but one or two spines.

Specimens examined.—2 ♂, 3 ♀.

UTAH: Logan Canyon, near mouth of cottonwood Canyon, ♀ type, 1 ♂, 2 ♀ paratypes, amongst sagebrush, altitude 5500 feet, July 2, 1924 (A. F. Braun) [A.F.B.Coll.].

BRITISH COLUMBIA: Oliver, 1 ♂, altitude 1000 feet, September 9, 1953 (J. E. H. Martin) [C.N.Coll.].

Food plant and early stages unknown.

The description of the fore wing is compiled in large part from the female type; in the other specimens the markings, though present, are less conspicuous, owing to fewer and paler dark-tipped scales. In genitalia, the slender harpes of the male, and the long sclerotized section of the ductus bursae separate *angustisquamella* from *seorsa* new species.

(59) ***Bucculatrix columbiana*** new species (Figs. 162, 162a, 163, 163a.)

Face white, tuft of white and gray hairs; eye-caps white, antennal stalk grayish white, with wide blackish annulations. Ground color of the fore wings white; markings formed by pale grayish ocherous and grayish ocherous dark brown-tipped scales; basal third of the wing sometimes immaculate, but more often with a few dark-tipped scales along costa near base and a patch of dark-tipped scales lying between fold and dorsum near base; at one-third of costa an oblique dark streak not reaching middle of wing; at middle of costa a larger dark patch and a little basad of it on dorsum, a large patch of dark-tipped scales, somewhat half-crescent-shaped, bears on its inner margin below fold, a few black raised scales; in the middle of the wing beyond these two patches of

dark-tipped scales is a considerable area of pale ochereous scales, scarcely perceptibly dark-tipped, which may spread toward costa and dorsum, thus occupying a considerable proportion of the apical third of the wing; within this area, a black discal dot; a short line of black scales, sometimes conspicuous, margins termen below apex; an irregular line of black-tipped scales through the grayish cilia from apex along termen. Hind wings gray, with faint coppery luster. Legs gray, tarsal segments darker-tipped. Abdomen grayish ochereous above.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 163, 163a). Harpe concave, the broad apex produced and bent toward the median line, upper margin bearing a row of conical setae, with an additional group of several such setae at tip; tegumen narrow and elongate, socii long setose, subscaphium a dorso-ventral plate; anellus an elongate cone; aedeagus very long, basal third wide, thence abruptly narrow, slightly expanding at tip; vinculum with a broad deep anterior sinus. Scale sac large, nearly equalling in length the second abdominal segment.

Female genitalia (figs. 162, 162a). Segment 9 modified, rasping rods strong, vaginal setae minute; on each side of segment 8 a group of long specialized scales; two minutely reticulate areas nearer median line; ostium opening in a deep broad depression with pointed flaring lateral margins; ductus bursae wide at ostium, bending to the right and rapidly narrowing; signum near posterior end of bursa copulatrix, ribs irregular, with one or more short ribs interpolated anteriorly between the long ribs, spines variable (fig. 162a).

Type.—♂, Kelowna, British Columbia, on *Iva axillaris* (James Fletcher) [U.S.N.M., Type No. 65030].

Allotype.—♀, same data as the type [U.S.N.M.].

Paratypes.—1 ♂, 1 ♀, and 1 ♂, 1 ♀ lacking hind wings and abdomen, same data as the type [U.S.N.M.].

The food plant, *Iva axillaris* Pursh, is a plant of widespread range in saline or alkaline soils of western United States and Canada. The white cocoons, with seven or eight, sometimes obsolescent ribs are spun on the underside of the coarsely hairy leaves.

The genitalia of the male separate this species from all others except the following, which differs only in minor, but definite, structural details.

(60) ***Bucculatrix sororcula*** new species (Figs. 164, 164a, 165, 165a.)

Face and tuft white, eye-caps white, antennal stalk white with blackish annulations. Thorax and fore wings white; pale ochereous brown-tipped scales form the marks, which may be distinct (♀ allotype), or obsolescent, with some faint or lacking (♂ type); a few pale ochereous scales along costa near base; a short oblique streak at one-third of costa; near middle of costa, a larger patch of

brown-tipped scales, and somewhat basad of it on dorsum a similar patch of scales (reduced to a faint ocherous shade in ♂ type), bearing on its inner side on the fold one to three black raised scales; an elongate black discal dot at end of cell (absent in ♂ type); a patch of brown-tipped scales at three-fourths of costa, not encroaching on the white costal cilia; a few black scales at extreme apex, and a few black-tipped scales in the white apical cilia. Hind wings pale gray, with paler cilia. Legs white, tarsal segments dark-tipped.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 164, 164a). Harpe very concave and fitting over the large convex and strongly sclerotized anellus, then with its broadly produced apex bent toward the median line (cf. left harpe in the figure); apex clothed with several rows of short conical setae (cf. *columbiana*); tegumen narrow and elongate, socii long setose; below each socius a narrow erect setose lobe arising from near margin of tegumen (not present in *columbiana*); aedeagus very long and slender except in basal fourth and extending forward from the tip of the socii to the posterior margin of segment 2 (about one-third longer than in the closely allied *columbiana*); vinculum with a broad anterior sinus. Scale sac small, half as large as in *columbiana*.

Female genitalia (figs. 165, 165a). Scarcely to be distinguished from the genitalia of *columbiana*, except that the rasping rods are less well-developed and less strongly sclerotized, and the signum ribs narrower and the spines more slender.

Type.—♂, Boyce Thompson Arboretum, Superior, Arizona, July 11, 1939 (A. F. Braun) [A.F.B.Coll.].

Allotype.—♀, Olancho, Inyo County, California, May 21–31 [U.S.N.M.].

Bucculatrix columbiana and *B. sororcula* furnish another example of the pairs of closely related species, so often occurring in this genus. The configuration of markings is the same in the two species, and by genitalia the females can scarcely be separated. In the male genitalia, however, the two species differ in the armature of the apex of the harpe, the much greater length of aedeagus in *sororcula*, and especially in the presence of the elongate setose lobes arising from tegumen below socii.

Although the food plant is not known, it is unquestionably a Composite, and may be the same as that of *columbiana* or another species of the genus *Iva*.

(61) ***Bucculatrix nigripunctella*** Braun (Fig. 166.)

1923. *Bucculatrix nigripunctella* Braun, Trans. Amer. Ent. Soc. XLIX: 125.

Type ♀, Palm Springs, California [A.F.B.Coll.].

Face white, tuft white, with a few pale gray hairs; eye-caps white, antennal stalk white, with dark fuscous annulations. Thorax white. Fore wings white, with a faint scarcely discernible pale grayish straw-colored suffusion along the middle of the wing nearly to apex; wings marked with black or black-tipped scales placed singly or in groups; a few (two to six) black scales in the basal half of the wing, two or three just above the fold, two or three below it; three small groups of black-tipped brownish scales on costa, about equally spaced, the first before middle, the third, placed before apex, is the largest; a line of three black scales in the disc at three-fourths; a group beyond middle of dorsum, and another at tornus, in which the scales are more narrowly dark-tipped; a considerable aggregation of black scales in apex extends along termen about half-way to tornus; minutely black-tipped scales form a broken line at the base of the white cilia. Hind wings and cilia white, with a faint ochereous tinge. Legs white, tarsal segments narrowly dark-tipped. Abdomen dull straw-colored.

Alar expanse 7.5 to 8 mm.

Female genitalia (fig. 166). Segment 9 modified, but rasping rods scarcely differentiated; on segment 8, lateral large patches of elongate specialized scales directed posteriorly and toward mid-ventral line; posterior to ostium near mid-ventral line, a pair of finely reticulate sculptured patches; on each side of ostium on the intersegmental membrane is a transversely elongate patch of very minute widely spaced slender scales; ostium large, minutely spinulose, tapering to the slender ductus bursae, which is sclerotized into segment 6; a short membranous section of the ductus enters bursa copulatrix in segment 5; signum weak dorsally, ribs long ventrally, where the spines are long and slender.

Specimens examined.—2 ♀.

CALIFORNIA: Palm Springs, Riverside County, ♀ type, ♀ paratype (not male as stated in the original description), March 26, 1917 [A.F.B.Coll.].

Food plant and early stages unknown.

The female only is known. The species may be recognized by the conspicuous black scales on the white fore wings and by the characteristic genitalia. The paratype shows fewer of the black scales in the basal and apical areas of the wing.

Although the rasping rods of the ninth segment are not well differentiated, the shape and modification of the ovipositor lobes indicate that *nigripunctella* should be assigned to this group.

(62) ***Bucculatrix atosignata*** new species (Figs. 167, 167a, 168, 168a, 168b.)

Face white, tuft white with a few pale gray hairs; eye-caps white, antennal stalk white with conspicuous blackish annulations. Thorax and fore wings white. The following description is based on the female type, with differences in the male allotype noted; the marks are formed by groups of broadly black-tipped scales conspicuously contrasting with the pure white ground color, and

by a few grayish scales along basal third of costa; at two-thirds of costa, a rather small patch of black-tipped ocherous scales (diffuse in the male and merely faintly brown-tipped); on dorsum, opposite this patch, a large irregular patch of black-tipped scales (in the male these scales pale brown-tipped as in the costal patch); the apical fourth of the wing is conspicuously blackish by an accumulation of the black-tipped scales, producing toward apex an evenly peppered aspect, and including some almost black spots (in the male, the scales of this area are pale brown-tipped as in the other marks); the inner margin of this area is irregular and produced toward base in the middle of the wing; a small triangular pure white costal spot indents it just before apex; some black-tipped scales project into the cilia along termen; cilia pure white. Hind wings and cilia white. Legs white, a little shaded with gray, tarsal segments narrowly gray tipped.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 168, 168a, 168b). Posterior margin of eighth sternite sclerotized; harpes almost cylindric, broadening at base, apices with strong conical setae; socii very long, slender, enlarging at the setose apex; a pair of spinulose ridges meeting at an acute angle below the anal opening; anellus large, exceeding tegumen; aedeagus short, cylindric, tapering slightly to the triangular aperture; vinculum a broad band, its posterior margin strongly sclerotized. Scale sac (fig. 168b) indistinctly bilobed, scales few and elongate.

Female genitalia (figs. 167, 167a). Entire ninth segment strongly sclerotized, apophyses heavy, clavate; rasping rods developed, vaginal setae large; ductus bursae expanding before the circular ostium; signum characteristic, each of the larger spine-bases of a signum rib dividing into three acute forks, each emitting a slender spine (fig. 167a).

Type.—♀, Eureka, Utah, May 30, 1911 (Tom Spalding) [U.S.N.M., Type No. 65031].

Allotype.—♂, same data as the type [U.S.N.M.].

Food plant and early stages unknown.

The female is chosen as the type because of its perfect condition, with contrasting black marks on a pure white ground. The male, though lacking the sharp contrast between ground color and markings, is recognizable as the same species.

Bucculatrix atosignata is distinct in wing color and marks, and in genitalia from all other species of our fauna.

(63) ***Bucculatrix enceliae*** new species (Figs. 24, 172, 172a, 173, 173a.)

Face white, tuft white or with an admixture of grayish hairs; the small white eye-caps not concealing the large eyes, annulations of antennal stalk varying from pale grayish ocherous in faintly marked specimens to dark brown in

the more conspicuously marked specimens. Fore wings white, with the better-defined marks formed by dark brown-tipped scales, and with a more general dusting, especially in the apical half of the wing, of paler minutely brown-tipped scales, leaving two undusted white costal streaks, and a white patch just before tornus; the marks may be obsolescent, most of the scales forming them scarcely dark-tipped, and finally the wings may be almost immaculate. When the marks are well-defined by dark brown-tipped scales (as in the female type, and to a less extent in the male allotype), they consist of a streak of dark brown-tipped scales along costa ending in a patch of dark brown-tipped scales just before middle of costa, which is followed by an oblique undusted white streak, separated from a second oblique white streak by an oblique streak of the dark brown-tipped scales which in the middle of the wing blends with the pale minutely brown-tipped scales; apical fourth of wing clothed with narrowly brown-tipped scales; a few dark brown scales at extreme apex and above them a narrow short longitudinal white line; a similar group of dark brown scales on middle of termen; just beyond middle of dorsum, a patch of dark brown-tipped scales may extend nearly to the middle of the wing, and is followed by a large patch of white scales; cilia gray opposite apex, shading to white at tornus, a line of dark-tipped scales through the cilia, becoming faint toward tornus. Hind wings and cilia pale grayish or whitish ochereous. Legs pale ochereous, shaded with fuscous, tarsal segments pale gray-tipped. Abdomen pale ochereous.

Alar expanse 7 to 9 mm.

Male genitalia (figs. 172, 172a). Harpe broadly rounded, costa for two-thirds its length margined with short heavy setae, setae around apex and on inner surface short and slender; socii elongate, setose, projecting but little beyond tegumen; gnathos a minutely spinulose hood; anellus lobed at apex; aedeagus slender, tapering gradually, but widening at aperture, two rows of acute teeth (cornuti) before aperture; vinculum triangular, heart-shaped. Scale sac present.

Female genitalia (figs. 173, 173a). Entire ninth segment strongly sclerotized and partially dark-pigmented; lobes of ovipositor fused with the body of the segment and only defined by setal arrangement, rasping rods strong, vaginal setae closely placed; apophyses appearing as anterior prolongations of the strongly sclerotized segment; lateral anterior margins of segment 8 produced and simulating a rudimentary second pair of apophyses; segment 7 overlies the base of segment 8, with a median pair of specialized scale tufts beneath its posterior margin, a second pair of tufts of longer specialized scales lateral to these, and attached beneath the overlying segment 7; ostium at the anterior margin of segment 8, with the membrane of segment 8 lateral to it minutely spinulose; a straight sclerotized section of ductus bursae is microscopically spinulose; signum a ring, the ribs irregularly spined, at least some of them bilaterally spined (fig. 173a).

Type.—♀, Whitewater, California, "on *Encelia farinosa*, iss. Mar. 10, 1930" (C. M. Dammers) [U.S.N.M., Type No. 65032].

Allotype.—♂, San Diego, California, April 24–30 [U.S.N.M.].

Paratypes.—3 ♀, same data as the type; 2 ♂, Palm Springs, Riverside County, California, March 20–30 [U.S.N.M.]; 2 ♂, 1 ♀, Palm Springs, California, March 26 and 28, 1917 (G. R. Pilate) [A.F.B.Coll.]; 1 ♂, Loma Linda, San Bernardino County, California, [U.S.N.M.]; 3 ♂, 1 ♀, Loma Linda, California, June 4, 16, 18, 1912 (G. R. Pilate) [A.F.B.Coll.]; 3 ♂, 1 ♀, San Diego, California, May (Ricksecker) [U.S.N.M.]; 3 ♂, 2 ♀, Boyce Thompson Southwestern Arboretum, Arizona, rearing record B.2312, imagoes April 23, April 27, 1962; 2 ♀, near Tucson, Arizona, rearing record B.2312, imagoes April 15, April 23, 1962; 2 ♀, Apache Trail, Arizona, rearing record B.2312, imagoes April 27, April 29, 1962 (A. F. Braun) [A.F.B.Coll. and A.N.S.P.].

The food plant of the Whitewater, California, and of the Arizona specimens is *Encelia farinosa* Gray (Brittle-bush), a widespread and common shrub of the deserts of Arizona, southern California and Mexico. *Encelia californica* Nutt., a shrub of the seacoast of southern California, is probably the food plant of the San Diego specimens.

The following description of the life history is based on the reared Arizona specimens.

The egg is placed on the upper side of the leaf, beneath and partially hidden by the pubescence; a short, more or less contorted mine, in which all the parenchyma is consumed, is scarcely visible except by transmitted light. The larva leaves the mine on the underside of the leaf, then feeding externally, skeletonizing irregular patches, with upper epidermis remaining intact. Feeding is completed early in April.

The cocoon, an intricate and beautiful structure, is usually spun on the upper side of the leaf, most often over the midrib. It consists of a dense inner ridged cocoon, covered by a broad thin outer sheet of silk. The ridges of the posterior section of the inner cocoon, except for one or two dorsal longitudinal ridges, slant backward at a very acute angle. This typical Bucculatricid cocoon is covered by a broadly elliptical sheet of thin open silken mesh, marked with slightly elevated and thickened ridges, which curve obliquely backward from the union of the two sections of the cocoon, and less obliquely forward.

The large eyes, conspicuous in the living insect, are a distinctive feature of the species. Many specimens (all of the Arizona series) lack the dark dusting of the fore wings; the aspect is that of a white ground,

marked with groups of dark-tipped scales, which do not define white streaks as described for dusted specimens. Pale or immaculate specimens, difficult to identify, may be determined with certainty by the characteristic genitalia.

Bucculatrix enceliae is the most specialized of the line of species with modified ninth segment of the abdomen of the female, involving the development of the inner margins of the ovipositor lobes into rasping rods, fusion of the remaining areas of the lobes with the membranous portion of the ninth segment, which in this species is completely sclerotized, and the transfer of function of the ovipositor lobes to the vagina with its specialized vaginal setae.

(64) ***Bucculatrix latella*** Braun (Figs. 169, 170, 170a, 171.)

1918. *Bucculatrix latella* Braun, Ent. News XXIX: 246. Type ♀, Loma Linda, California [A.F.B.Coll.].

1958. *Bucculatrix latella* Braun, Trans. Amer. Ent. Soc. LXXXIV: 107.

Face white, tuft white, with ocherous hairs in the middle posteriorly; eye-caps white, antennal stalk with pale gray annulations. Fore wings white, with scattered minutely brown-tipped pale ocherous scales, and an occasional black-tipped scale; a broad ocherous streak, sometimes obsolescent, from base along fold to one-fifth; on middle of dorsum a large conspicuous ocherous patch, bearing on its inner side just above dorsum a group of darker brown-tipped raised scales; a little distad of this on costa, a closer grouping of the scattered pale ocherous scales sometimes forms a more or less distinct ocherous patch; at end of cell, a minute, but distinct black dot; apex of the wing occupied by brown-tipped ocherous scales, the ocherous shade sometimes lacking, leaving only the minute brown tips; cilia white, occasionally with a few dark-tipped scales projecting into them opposite apex, but no ciliary line. Hind wings white or whitish ocherous, cilia concolorous at bases, shading outwardly to white. Legs whitish ocherous, tarsal segments grayish ocherous-tipped. Abdomen whitish.

Alar expanse 9.5 to 12 mm.

Male genitalia (fig. 169). Harpes cylindric, curved, their tips meeting in median line before spreading, with dense short heavy setae along apex; socii setose, long, tegumen with an elongate median lobe, subscaphium elongate, bilaterally spinulose; anellus elongate, constricted in the middle; aedeagus slender throughout; vinculum moderately wide. Scale sac large, scales slender and densely packed.

Female genitalia (figs. 170, 170a, 171). Segment 9 highly modified, ovipositor lobes fused with the sclerotized segment, their tips prolonged into strongly sclerotized cutting points, vaginal setae with thick curved outer margins; apophyses strong; sternite of segment 8 with two lateral anteriorly projecting lobes, its lateral margins fringed with long hair-scales, and a pair of latero-ventral

tufts of specialized scales; on posterior margin of segment 7, a scale tuft mid-ventrally (not shown on figure) and long hair-scales mid-dorsally; except for the ovipositor setae and the specialized scales, segments 8 and 9 are naked, and visible in the dry specimen; ostium rounded, diverging lines in the depression on segment 8; signum obliquely placed, ribs with long slender spines.

Specimens examined.—12 ♂, 5 ♀.

CALIFORNIA: Loma Linda, ♀ type, June 3, 1912, 1 ♂ paratype, April 21, 2 ♂ paratypes, June 1, 4 (G. R. Pilate) [A.F.B.Coll.]; Monache Meadows, Tulare County, 8000 feet, 1 ♂, 1 ♀, July 13, 1917 (G. R. Pilate) [A.F.B.Coll.]; 8 ♂, 2 ♀, July 1–14, July 24–31 [U.S.N.M.].

ARIZONA: Flagstaff, 1 ♀, July 18, 1939 (A. F. Braun) [A.F.B.Coll.].

Food plant and early stages unknown.

In general aspect, *B. latella* resembles *B. eurotiella* Walsingham from which it may be distinguished by the black dot at end of cell, the white cilia without ciliary line of dark-tipped scales, and the absence of dark-tipped scales along termen. The very different genitalia of the two species indicate no near relationship.

SECTION III

Species 65

One species, *Bucculatrix sporobolella* Busck, is assigned to a separate section of the genus on the basis of the unique male genitalia and the unusual food plant, a species of grass.

(65) ***Bucculatrix sporobolella*** Busck (Figs. 174, 174a, 174b, 175, 175a.)

1909. *Bucculatrix sporobolella* Busck, Proc. Ent. Soc. Wash. XI: 183. Type ♀, Cimarron, New Mexico [U.S.N.M., Type No. 12691].

Face creamy white, tuft white below, largely reddish ochereous or dark gray above; eye-caps creamy white, antennal stalk white with blackish annulations. Thorax white, dusted with reddish ochereous or fuscous. Basic ground color of the fore wings white, but so closely overlaid with minutely reddish ochereous- or fuscous-tipped scales as to obscure the ground color; the markings are produced by evenly reddish ochereous or fuscous scales, with which are mingled black scales, most numerous along the outer margins of the oblique streaks, thus defining them; at basal third, a very oblique costal streak; before apical third, a second broader and more conspicuous streak, more densely dusted with black scales, curves upward in the middle of the wing and may as a narrow line reach the apex; this streak is in part margined above with white scales; a longitudinal reddish ochereous or blackish streak in the fold may or may not curve downwards and connect with a very oblique streak arising just within the middle of

dorsum, curving and following the fold; a group of black scales lies on the inner margin of this streak below fold; apex of wing more or less dusted with black-tipped scales; two lines of black-tipped scales in the cilia, one near base, one near tip. Hind wings and cilia fuscous. Legs silvery ochereous, tarsal segments more or less broadly black-tipped. Abdomen silvery beneath, dark fuscous above.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 174, 174a, 174b). Harpes broad at base tapering to the narrow cucullus, armed with heavy setae at apex, free costal arms curving; tegumen expanding into large broad wings, their sclerotized outer margins with a line of inwardly directed fine setae; socii small, slender, cylindric, terminating in a flat circular setose pad; two erect small elongate angled processes arising in mid-line may represent the gnathos; anellus globular, lobed at apex; vinculum narrow, produced as a broad median lobe posteriorly, emarginate anteriorly; aedeagus curved, gradually tapering to the slender apex; cornuti a long row of short spines. Scale sac large, scales clustered (fig. 174b).

Female genitalia (figs. 175, 175a). Ductus bursae sclerotized nearly to anterior margin of segment 6 and bending to the right, wider before ostium; on each side lateral to ostium, on the intersegmental membrane, a patch of small specialized scales; acuminate diverging sclerotizations from dorsal margin of ostium; broadly expanded finely setose free flaps flank the latero-ventral margins of ostium; on dorso-lateral posterior margin of sclerotized basal half of segment 8, a small curved sclerotized process; signum strong, the dorsal ribs one-half or less the length of the ventral, spines long acicular (fig. 175a).

Specimens examined.—2 ♂, 4 ♀.

NEW MEXICO: Cimarron, ♀ type (genitalia slide No. 10414, J. F. G. C.), on *Sporobolus airoides*, Sept. 1907 (C. N. Ainslie) [U.S.N.M.]; ♀ cotype, same data as the type.

CALIFORNIA: Loma Linda, San Bernardino County, 1 ♂ [genitalia, fig. 174], 1 ♀, July 11, 1912, 1 ♂, 1 ♀, October 15, 1912 (G. R. Pilate) [A.F.B.Coll.].

The dates, July and October, of the California specimens indicate two generations a year; however, no data on the larval habits are available. *Sporobolus airoides* Torr., a species of grass, is an unusual and unexpected food plant for a species of *Bucculatrix*. The cocoon is pure white, extremely slender and pointed, evenly ribbed; length 8 mm.

This species can be recognized by the characteristic wing markings, especially by the second costal streak, with white scales margining it on its upper side (i.e. toward costa) in the middle of the wing. The genitalia, especially the unique male genitalia, different from anything known in the genus, at once identify it. The heavy setae of apex of harpe and the female genitalia suggest relationship to the Composite feeders (Section II) and raise a doubt of the food plant association.

SECTION IV

Species 66 to 90

The larvae of species of this section, whose food plants are known, feed, with few exceptions, on members of amentiferous plant families (as *Quercus*, *Betula*, *Corylus*, *Alnus*). The imagoes have a distinctive type of genitalia in both sexes, indicating descent from a common ancestor. The European *B. thoracella* Thunb. belongs in this section.

Typical of the section in the male (figs. 179, 181, 186, 190, 201, *et al.*) are the small rounded harpes, setose inwardly and outwardly, which have assumed a ventral position, with the free arms of costa lying in a more or less ventral position; costa often with a small pointed basal process which engages vinculum; the inner concave membranous basal area of harpe closely associated with anellus (fig. 189); anellus with sclerotized lateral rods; aedeagus usually short, stout cylindrical with acute apex, aperture ventral to and basad of the apex; vinculum usually very narrow, often thread-like. As specialization proceeds, modification of these organs takes place, and the final product may diverge widely from the type just described (see figs. 204, 207, 216, 217, 219, 222, 224). In the last mentioned species (*eclecta*, fig. 224) the lobing of the harpe suggests a relationship with the Malvaceous feeders.

In the females of this section, segment 8 is partially retracted into segment 7, and the sternite of the sclerotized basal half of segment 7 and its membranous posterior half (the intersegmental membrane) partially overlie the sternite of segment 8, thus lying ventral to the basal half of segment 8 and the ostium. This overlying sclerotized basal half of segment 7 thus forms a protective covering for the loosely attached tufts of non-striated specialized scales on the intersegmental membrane, then ventral to the ostium, and on the basal half of segment 8, lateral to the ostium. For the relation of these segments and the position of specialized scale tufts, see Figure 176; the positions of such tufts are shown by heavy black dots. In addition to the ventral tufts of specialized scales, there are in most species of this section clusters of specialized scales attached at the dorsal anterior margin of segment 8 (fig. 176). The shape and arrangement of these scales are distinctive (see figs. 182, 184, 191, *et al.*). Fringing the posterior margins of both

tergite and sternite of segment 7 are rows of more or less specialized scales, attached at the anterior margin of the intersegmental membrane, and lying beneath and hidden by the normal body scaling; such fringes are shown in Figures 182, 185, 191, *et al.* The shape of sclerotized areas contiguous to the ostium may have specific value. In the females of this section, there is less departure from the general type than in males; however, comparison of the figures will show some degree of variation and further specialization.

Distinctive characters of the genitalia are mentioned in the description of each species of this section.

The general aspect of the species of this section is such that specimens can often be tentatively assigned to it, awaiting verification of their position by examination of genitalia. In color they vary from a white ground (*copeuta*) or nearly white or pale ocherous ground (*packardella*, *albertiella*) with more or less dark dusting, to a rather uniform ocherous color (*trifasciella*, *coronatella*), and finally to an almost black ground (*fugitans*, *locuples*); in general, three more or less well-defined pale or sometimes lustrous silvery oblique costal bars may be distinguished, separated by the ground color. The patch of raised scales on or just within the dorsal margin is usually large and conspicuous.

(66) ***Bucculatrix packardella*** Chambers

(Figs. 21, 52, 52a, 52b, 52c, 178, 178a, 179, 179a, 179b.)

1873. *Bucculatrix packardella* Chambers, Canad. Ent. V: 151. Type locality, Kentucky (near Cincinnati, Ohio). [Two specimens thus named, presumably by Chambers, in the Museum of Comparative Zoology, but not labeled types, do not represent this species.]

1875. *Bucculatrix packardella* Chambers, Cin. Quart. Journ. Sci. II: 120.

1923. *Bucculatrix packardella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 158.

Face creamy white, minutely brown speckled; tuft whitish, tips of hairs brown; eye-caps white, minutely brown speckled, stalk whitish, annulate with dark brown, the rings narrower than the distance between them. Thorax white, with brown specks. Ground color of the fore wing creamy white, the ground color in the basal half somewhat obscured by the fine dusting of minutely brown-tipped scales; in the apical half of the wing, the scales, basad of their brown tips, are pale golden brown or orange tinged, the outer half of the wing thus contrasting with the pale basal half of the wing; this orange color borders the

costa and forms an orange streak along the fold; on costa, immediately before the orange or golden shade of the apical half of the wing, the white ground color is less densely dusted, forming the semblance of an oblique streak which is sometimes margined inwardly by the deeper color; beyond middle of costa, an oblique white, but lightly dusted, streak crosses the wing to termen; an indistinct whitish spot before apex; on middle of dorsum a group of raised scales forms a dark brown or blackish spot, usually conspicuous and extending to the fold; a blackish apical spot, from which a few dark-tipped scales form a short line in the cilia below apex; a line of dark-tipped scales in the middle of the cilia curves around apex. Hind wings and cilia pale straw-colored. Legs pale straw-colored, tarsal segments often dark-tipped. Abdomen pale, sometimes with a slight fuscous shading, anal tuft paler.

Alar expanse 6 to 6.5 mm.

Male genitalia (figs. 179, 179a, 179b). Harpes typical of the section, short setose on inner and outer surfaces; socii small, inwardly curving, short setose; anellus a broad short truncated cone; aedeagus short, stout, bent dorsad near tip, its abruptly acute tip directed dorsad, aperture oval; vinculum a very narrow band. Scale sac elongate, scales slender (fig. 179b).

Female genitalia (figs. 178, 178a). The slender scales fringing posterior margins of segment 7 but little specialized; on the intersegmental membrane ventral to ostium, an arch of dark specialized scales, the scale-mass densest and broadest laterally, in mid-ventral line slightly emarginate; a small sclerotized plate posterior to ostium; ductus bursae long, with sclerotized strips bearing scattered teeth; bursa elongate, extending into segment 1, signum in segment 3; signum ribs with curved spines directed posteriorly.

Specimens examined.—Over 100, representing both sexes.

OHIO: Cincinnati, 7 ♂, 6 ♀, March 29 to May 15; 2 ♀, rearing record B.2217, on *Quercus shumardii* Buckl., imagoes March 29 and April 3; 2 ♂, 2 ♀, rearing record B.753, on *Quercus shumardii*, imagoes June 26 to June 30; 4 ♂, 3 ♀, July 1, July 3; 6 ♂, 5 ♀, August 6 to September 8, all emerging from typical cocoons; 1 ♂, November 15 (A. F. Braun) [A.F.B.Coll.]; 6, ♂, ♀, April 29 to May 13 (A. F. Braun) [U.S.N.M.]; 2 ♂, ♀, May 5, May 17 (A. F. Braun) [A.N.S.P.].

MICHIGAN: Livingston County, 1 ♂, August 7 (Ralph Beebe).

ONTARIO: Toronto, 3 ♂, 1 ♀, July (H. S. Parish) [J. R. Eyer Coll.]; 3 ♂, 1 ♀, 25.5.15 (H. S. Parish) [Cornell U.].

PENNSYLVANIA: Philadelphia, 2 (sex not determined), March 16, April 21 (F. Haimbach) [A.N.S.P.]; 2 ♂, 2.22.14 [Cornell U.]; Roxborough, 1 (sex not determined), May 19 (F. Haimbach) [A.N.S.P.].

DISTRICT OF COLUMBIA: Washington, 1 ♀, "on oak," iss. April 17, 1903 (August Busck) [U.S.N.M.]; 1 ♀, "on tulip," May 13/85 (C. V. Riley Coll.) [U.S.N.M.]; (without locality) 1 ♂, 9/5/85, "Beech," 1 ♂, 28/4/85, with cocoon, "Beech," 1 ♀, 15/5/85, with cocoon, "Beech," all bearing the number 3635 (C. V. Riley Coll.) [U.S.N.M.].

DELAWARE: Wilmington, 2 ♂, 2 ♀, June 4, July 10 to 16 (D. F. Bray); Stanton, 3, ♂, ♀, June to July 3 (D. F. Bray) [U. of Del.].

NEW JERSEY: New Lisbon, 1 ♀, May 17, 2 ♀, July 26, 2 ♀, Aug. 28 (Darlington Coll.) [A.N.S.P.]; Caldwell, 1, May 11 (W. D. Kearfott); Watchung Mts., 4, ♂, ♀, April 3, April 25; Essex Co., "on chestnut," May 15, "on oak," May 4, May 15; Montclair, July 18, "on oak," Sept. 20; Essex Co. Pk., 1 ♂ with cocoon, "hickory," May 4 (W. D. Kearfott) [all U.S.N.M.].

NEW YORK: "N. Y.," 1 ♂, 5 ♀, (Coll. Beutenmueller) [U.S.N.M.]; Monroe County, 4 ♀, "ex oak," May 3 to May 14, 5 ♂, 3 ♀, May 2 to June 3, 1 ♀, August 14 (C. P. Kimball) [C. P. Kimball Coll.]; 1 ♂, June 3, 1 ♀, "on oak" (C. P. Kimball) [A. E. Brower Coll.]; Hemlock Lake, 1 ♀, 1.IX.16 [Cornell U.].

RHODE ISLAND: Elmwood, 3 ♂, 2 ♀, May 6, June 10 to 30, July 28 (E. D. Keith) [A. E. Bower Coll.].

The larvae are miners in the first three instars, later feeding exposed on the underside of leaves of various species of oaks (*Quercus* spp.), and occasionally, perhaps accidentally, on beech. The egg is deposited on the upper side of the leaf. The short thread-like mine (fig. 52a) at first follows a vein, often the midrib, later sharply diverging from it. After leaving the mine, and moulting in the small open-mesh moulting cocoon on the underside of the leaf (fig. 52b), the larva eats small irregular patches of leaf tissue, leaving the upper epidermis; the second moulting cocoon is similar to the first, but slightly larger. The mature larva is dull green, with pale tubercles; setae long. The white cocoon (fig. 52c) is characterized by the many closely placed fine ridges, 10 to 12 in number. It is spun on leaves or bark of trees, or in herbage beneath the tree, descending by a silken thread which may be blown for as much as 40 feet from the food tree. On a vertical surface, as a tree trunk, the anterior end is placed downward. A single oak leaf may have a dozen or more mines; shaded leaves as well as leaves of the upper canopy are mined.

In the latitude of Cincinnati, there are three generations a year; imagoes emerge from overwintering cocoons from late March to early May; a second generation appears in late June; the third from mid-August to early September, some of these possibly hibernating; larvae hatching from eggs laid by this generation of moths become full-fed in late fall; the winter is passed in the pupal state.

The description of the moth is based on reared material in perfect condition from Cincinnati, that is, essentially from the type locality. It is one of our commonest species and widespread. The pure white, finely ridged cocoon, with many ridges in contrast to the few ridges of related species, is the best diagnostic character for reared material. A similar cocoon, but with a few less ridges, is found in *B. luteella* Chambers, and in *B. recognita* new species; from the former, the moth is separated by the apical spot and dark ciliary lines; from the latter by the absence of an oblique fascia at basal third; from both by the very different genitalia of both sexes. The fine speckling of the face and antennal eye-caps, present also in the Pacific Coast *B. albertiella* Busck, is a good diagnostic character for the eastern species. The combination of a conspicuous arch of dark specialized scales ventral to ostium (without additional groups of specialized scales) and the dentate ductus bursae occurs in *B. packardella* and in *B. albertiella* only.

(67) **Bucculatrix albertiella** Busck (Figs. 180, 180a, 180b, 181.)

1909. *Bucculatrix albertiella* Busck, Proc. Ent. Soc. Wash. XI: 184. Type ♂, Alameda County, California [U.S.N.M., Type No. 12693].

1910. *Bucculatrix tetralla* Braun, Ent. News XXI: 175. Type ♂, Mills College, Alameda County, California [A.F.B.Coll.]. (**New synonymy.**)

Face white, minutely dark-ocherous speckled; hairs of tuft mixed whitish and reddish ocherous, the reddish ocherous predominating; antennal eye-caps whitish, dotted with dark ocherous, stalk annulate with golden or dark brown. Thorax creamy white, brown dotted. Fore wings creamy white, dusted with minutely brown-tipped scales; the markings are produced by bands and patches of pale lustrous scales; these are four in number, the first near base and sometimes produced along fold; the second and third are oblique bands crossing the wing, the second to middle of dorsum, sometimes broken or ill-defined at its middle, and on its inner margin below fold a conspicuous tuft of black-tipped raised scales; the third, more evenly outlined, crosses the wing to tornus where it is broadest; the fourth is a more or less triangular patch at apical fourth of costa, nearly crossing the wing; between these marks are oblique more or less dusted pale streaks and bands, one indistinct near base, the second and third crossing the wing; a few black-tipped scales at apex form a slightly curving apical spot; cilia pale ocherous, with a line of narrowly black-tipped scales curving around apex. Hind wings and cilia pale grayish ocherous. Legs ocherous, fuscous-shaded, hind tarsal segments black-tipped. Abdomen silvery beneath, grayish ocherous and fuscous-shaded above.

Alar expanse 8 mm.

Male genitalia (fig. 181). Harpes typical of the section, long curved setae on inner and outer surfaces, costa with small basal process; socii stout, incurved, setae long; aedeagus short, stout, abruptly narrowing to the acute tip directed dorsad. Scale sac large, globular, scales slender.

Female genitalia (figs. 180, 180a, 180b). On intersegmental membrane ventral to ostium, an arch of black specialized scales, the arch broadest at each end with several rows of scales, narrowing mid-ventrally to a line of small scales; a curved sclerotized plate posterior to ostium; ostium wide, with flaring sclerotized walls; ductus bursae wide, with a sclerotized band bearing rows of minute teeth; signum a ring constricting bursa copulatrix near its posterior end; signum ribs with curved spines directed posteriorly, a few minute accessory spines.

Specimens examined.—34, representing both sexes.

CALIFORNIA: Alameda County, ♂ type, "Larva on *Quercus agrifolia*," May [U.S.N.M., Type No. 12693]; 7 cotypes, ♂, ♀, four of these "Larva on *Quercus agrifolia*," May [U.S.N.M.]; 7, ♂, ♀, May [U.S.N.M.]; 1 ♂ [A.F.B. Coll.]; 1 ♂, VI.4.1908, (G. R. Pilate) (type of *tetrella* Braun) [A.F.B. Coll.]; 2 ♂, 4 ♀, May 22 to June 7 (paratypes of *tetrella* Braun) [A.F.B. Coll.]; San Francisco, 1 ♂, 1 ♀, May 18, 19, (H. H. Keifer) [U.S.N.M.]; 1 (sex not determined), "on oak," Sept. 19 (ex Cal. Acad. Sci.) [U.S.N.M.]; 1 ♂, "on *Quercus agrifolia*," June 1 (Wild Coll.) [Cornell U.]; 1 ♀, October 4 (H. H. Keifer) [Cornell U.]; Stanford, Santa Clara Co., 3 ♂, 1 ♀, "reared from *Q. agrifolia*," IV. 18. 46, em. V.22.46 (J. W. Tilden) [A.F.B. Coll.]; Santa Barbara, 2 ♀, reared from cocoons on *Quercus agrifolia* Née, rearing record B.860, imagoes August 8, 1915 [A.F.B. Coll.]; Westwood Hills, Los Angeles Co., 2 ♀, "ex live oak" (H. M. Bohart) [A.F.B. Coll.].

The range of *B. albertiella* is probably coextensive with that of its food plant, *Quercus agrifolia* Née, that is, it may be expected in the coastal areas and valleys of California south of San Francisco Bay. Farther to the east (in the foothills of the Sierras) another species (*B. zophopasta* new species) seems to replace it. In the original description (Busck, 1909, *l.c.*) the cocoon is described as "pure white, rather bluntly rounded at the ends, evenly ribbed; length, 6 mm."

The near relationship of this species to the eastern *packardella* is evident from a comparison of the female genitalia. The long setae of the socii and harpes separate *albertiella* from all other oak-feeding species.

(68) ***Bucculatrix coniforma*** new species (Figs. 184, 184a, 184b.)

Face creamy white, tuft reddish ochereous; eye-caps and the two following segments of antennae creamy white, remaining segments extremely short and annulate with dark brown, producing a series of very narrow rings. Scales of

thorax broadly tipped with reddish ochereous, especially anteriorly. Fore wings creamy white, the ground color obscured by the dusting of ochereous- or dark-brown-tipped scales; a dusted area occupies the basal fourth of wing and is produced along the fold; following this is an oblique undusted costal streak, narrow near costa, angulated above fold and continued to dorsum as a broad band; an oblique dusted band borders this outwardly and below middle of wing is continued to termen as a broad darkly dusted band, and is marked on its inner border on the fold by a few dark brown raised scales; from middle of costa, an oblique creamy white streak; at two-thirds of costa, a narrow creamy white streak; apical area paler, more evenly ochereous; a black apical spot, continued along the bases of the whitish ochereous cilia toward tornus as a fine blackish line; a second dark line in the middle of the cilia curves around apex and extends nearly to tornus. Hind wings and cilia fuscous. Legs pale whitish ochereous, shaded with fuscous, tarsal segments broadly blackish-tipped.

Alar expanse 7.5 mm.

Female genitalia (figs. 184, 184a, 184b). On the ovipositor lobes, minute setae amongst the typical long setae; posterior margin of segment 7, both dorsally and ventrally, fringed with specialized scales, those of the ventral margin of several sizes; sternite of 7 sculptured; on the intersegmental membrane and ventral to ostium, an inverted V-shaped arch of specialized scales; on the anterior dorsal margin of segment 8, a row of minute, dark-pigmented scales, cylindrical in shape and tapering to a conical apex (fig. 184a); ostium with lateral anteriorly directed acute wings; ductus bursae sclerotized to inception of ductus seminalis. Signum broad ventrally, very narrow, nearly obsolete dorsally; signum ribs irregularly spined (fig. 184b).

Type.—♀, Martha's Vineyard, Massachusetts, August 6 (F. M. Jones) [A.N.S.P., Type No. 7815].

Food plant and early stages unknown.

The sort antennal segments of the moth, narrowly ringed with brown and white, and the female genitalia separate this species from all others of this section.

(69) ***Bucculatrix platyphylla*** new species

(Fig. 183.)

Face creamy white, tuft of mingled white, pale ochereous and brownish hairs; eye-caps creamy white, antennal stalk whitish, annulate with dark brown for over half its length, then follow several brown segments, then two white, separated by a brown segment, then several brown segments, last few segments whitish, faintly brown-dotted. Thorax ochereous. Ground color of the broad fore wings predominantly pale straw-color, with the marks formed by ochereous, more or less conspicuously brown-tipped scales; a patch of such scales along costa at base, a second similar, slightly broader patch before middle of costa, a large conspicuous brownish ochereous patch at two-thirds, extending obliquely to

the middle of the wing; scales of basal half of wing below fold minutely brown-tipped, below middle of fold a black spot with a few raised scales, followed by ocherous and brown-tipped scales; apex of wing with a golden ocherous patch; cilia shading to pale fuscous outwardly, no ciliary line. Hind wings very broad (half again as broad as usual), pale grayish ocherous, somewhat irrorated. Legs pale straw colored.

Alar expanse 9 mm.

Female genitalia (fig. 183). Fringing scales of segment 7 short, except laterally on sternite; on intersegmental membrane an acute arch of minute specialized scales, its ends curving very slightly outward; no specialized scale tufts on sternite of segment 8; on dorsal anterior margin of 8, a line of minute specialized scales; ostium bowl-shaped, ductus bursae short, entering dorsally the anterior lobe of the bilobed bursa copulatrix; the posterior and smaller lobe receives the ductus seminalis; signum ribs long, with acute spines posteriorly, attenuated and ending in a series of minute spines and knobs.

Type.—♀, E. Aurora, New York, May 18, 1913 (W. Wild Coll.) [Cornell U., Type No. 3645].

Food plant and early stages unknown.

Represented by the female type only.

The broad wings, especially the broad hind wings, broader than in any other species observed, will enable immediate recognition of this species; the specific name, *platyphylla*, refers to the broad wings. The bilobed bursa copulatrix, with inception of the ductus seminalis in the small posterior lobe, is unique in the genus, so far as observed.

(70) ***Bucculatrix ochrisuffusa*** new species (Figs. 182, 182a.)

Face pale ocherous, tuft reddish ocherous; eye-caps pale ocherous, antennal stalk indistinctly annulate. Thorax reddish ocherous. Fore wings bright reddish ocherous, with a few brown-tipped scales on the costal area beyond middle and along dorsum from the patch of raised scales to tornus; apical area paler; markings ill-defined, indicated only by their paler color; an oblique streak from basal fifth of costa, a similar but shorter and narrower streak from near middle of costa; on middle of dorsum, a large patch of blackish brown raised scales, extending to fold; the ground color a little paler basad of the raised scales; no apical spot, no ciliary lines. Hind wings and cilia brownish fuscous, darker than the fore wings. Legs ocherous, slightly shaded with fuscous. Abdomen fuscous above, paler beneath.

Alar expanse 8 mm.

Female genitalia (figs. 182, 182a). Ovipositor lobes with minute setae amongst the typical long setae; sternite of segment 7 sculptured, dorsal posterior margin fringed with long specialized scales, ventral margin, except mid-ven-

trally, fringed with specialized scales which progressively become longer laterally; mid-ventrally, on intersegmental membrane, a pair of small scale tufts; on each side of ostium, on sternite of 8, a large dense patch of dark specialized scales; on anterior margin of segment 8, mid-dorsally, a pair of scale patches of few scales, lying transversely; ostium flaring, with lateral acute anteriorly directed points; ductus bursae contracting before ostium, gradually enlarging to bursa; signum a broad ring, the ribs irregularly spined, the spines continuing as detached fine points (fig. 182a).

Type.—♀, Cincinnati, Ohio, June 6, 1910 (A. F. Braun) [A.F.B.Coll.].

The food plant of this species is probably white oak (*Quercus alba* L.).

Bucculatrix ochrisuffusa agrees with *luteella* Chambers in the ill-defined markings and absence of apical spot and ciliary lines, but is at once separated from it by the more reddish color of the fore wings, the larger size, and especially by the different female genitalia.

(71) ***Bucculatrix trifasciella*** Clemens

(Figs. 15, 16, 32, 53, 185, 185a, 186, 186a.)

1866. *Bucculatrix trifasciella* Clemens, Proc. Ent. Soc. Phila. V: 147. Type ♂, Pennsylvania (probably Easton) [A.N.S.P., Type No. 7500].

1872. *Bucculatrix trifasciella* Stainton, Tin. No. Amer., p. 272.

1873. *Bucculatrix trifasciella* Chambers, Canad. Ent. V: 149.

1875. *Bucculatrix trifasciella* Chambers, Cin. Quart. Journ. Sci. II: 120. (Mere mention.)

1903. *Bucculatrix trifasciella* Busck, Proc. Ent. Soc. Wash. V: 220.

1873. *Bucculatrix obscurolfasciella* Chambers, Canad. Ent. V: 150. Type ♀, Kentucky [M.C.Z.]; "Type" ♀, Kentucky [U.S.N.M.].

Face pale whitish ochereous, tuft reddish ochereous; eye-caps white or tinged with ochereous, antennal stalk annulate with blackish brown. Thorax ochereous. Fore wings ochereous, marks (typically) silvery in male and sharply defined (fig. 15), dull whitish or pale ochereous in female, sometimes faintly dusted and not sharply defined (fig. 16). Three equidistant oblique costal streaks, the first from basal fourth, the third from two-thirds the wing length, its apex nearly meeting, at an angle, the tip of a similar dorsal streak from just before tornus; on middle of dorsal margin a blackish brown patch of raised scales extending to fold, preceded by a paler spot (never silvery), and followed by a patch of brown-tipped scales limited outwardly by the dorsal silvery (or pale ochereous) streak; a blackish apical spot, preceded in the male by a few silvery scales; in the cilia and not in contact with the apical spot, a line of dark-tipped scales, curving around apex and extending through the terminal cilia toward tornus, this line sometimes indistinct below apex. Hind wings and cilia fuscous in male, paler and more ochereous in female. Legs ochereous, fuscous shaded, hind tarsal segments broadly blackish-tipped. Abdomen fuscous above, ochereous beneath.

Alar expanse 7.5 to 8 mm.

Male genitalia (figs. 186, 186a). Harpes typical of the section, setose outwardly and sparsely inwardly, terminating in a small pointed process, basal process present; socii short, broad, and widely separated, sinus between them shallow; anellus with strongly sclerotized lateral rods; aedeagus short, stout, with lateral rounded bulges before the narrow and acute tip; vinculum thread-like. Scale sac very large.

Female genitalia (figs. 185, 185a). Fringing scales of posterior margins of segment 7 long; on intersegmental membrane ventral to ostium, a semicircle of long specialized scales; on each side of ostium on sternite of 8, a large patch of specialized scales; minute specialized scales at anterior margin of tergite of 8 attached to a narrow transverse plate; margin of ostium outcurved and sclerotized. Spines of signum ribs long and slender (fig. 185a).

Specimens examined.—21 ♂, 21 ♀, and 25 sex not determined.

PENNSYLVANIA: Easton (?), ♂ type [A.N.S.P.]; Hazleton, 1 ♂, 2 ♀, July 13, 17, 29 (W. G. Dietz) [A.N.S.P.]; 1 ♂, June 8 [Cornell U.]; Folsom, 1 ♀, 5.7.91 [A.N.S.P.]; Arendtsville, 1 (sex not determined), July 6, 1921, "on oak" (S. W. Frost) [A.N.S.P.].

NEW JERSEY: 15, ♂, ♀ (probably W. D. Kearfott) [U.S.N.M.]; New Lisbon, 6, ♂, ♀, June 11, June 18, three of these labeled "from small green larvae feeding naked underside scrub oak"; 1, "emerged August 31, 1938, leaf miner white oak, underside," 1, "underside oak leaves," emerged June 20; 1, August 7, 1938, "on oak"; 2 ♀, July 13, July 16, 1942; Whitesbog, 1 ♀, July 26, 1940 (E. P. Darlington) [A.N.S.P.]; Wenonah, 2 ♀, V.15.10 (F. Haimbach) [A.N.S.P.].

KENTUCKY: ♀ type of *obscurofasciella* (V. T. Chambers) [M.C.Z.]; ♀ "type" of *obscurofasciella* (V. T. Chambers) [U.S.N.M.]; 1 specimen without locality label (from Chambers) [A.N.S.P.].

OHIO: Cincinnati, 1 ♂, 1 ♀, rearing record B.654, on *Quercus palustris* Muenchh., imagoes April 27, 29; 1 ♀, rearing record B.493, on *Quercus palustris*, imago August 27, from typical dark gray cocoon; 2 ♂, on oak, imagoes August 6; 1 ♂, on *Quercus bicolor* Willd., imago July 19; 1 ♂, "on red oak," imago July 9; 3 ♂, 3 ♀, May 13 to June 26; 2 ♂, August 1 and 14; 4 ♂, 2 ♀, rearing record B.2287, emerging from gray cocoons, April 26, April 30 (A. F. Braun) [A.F.B.Coll.]; 1 ♂, 1 ♀, (A. F. Braun) [U.S.N.M.]; Clermont County, 1 ♂, June 27; Mineral Springs, Adams County, 1 ♂, June 27, 1 ♀, July 20 (A. F. Braun) [A.F.B.Coll.]; Fort Hill, Highland County, 1 ♀, rearing record B.2220, on *Quercus rubra* L. (*Q. borealis maxima*), imago April 22 (A. F. Braun) [A.F.B.Coll.].

ONTARIO: Sparrow Lake, 1 ♂, 1 ♀, July 11, 17, 1926 (A. F. Braun) [A.F.B. Coll.].

No LOCALITY: 2 ♂, nos. 570, 575. "Walsingham det." [A.N.S.P.].

The larvae of *B. trifasciella* feed on leaves of various species of oak; red oak, *Quercus rubra* L. (*borealis maxima*), in many localities appears to be the preferred food plant. Feeding usually takes place on leaves high up in the tree. The mine is similar to that of *packardella*, the moulting cocoons (both first and second) somewhat larger than those of *packardella*; the exposed larva may feed on either the upper (B.493 and B.654) or the lower side of the leaf. The cocoon (fig. 53) broad and stout, with six or seven ridges, is characterized by the fusion or anastomosis of ridges; it may be either dark gray (as described by Clemens) or pale gray or even whitish. In the generation emerging in the summer (i.e. in the same season) the cocoon is generally spun on the underside of a leaf, often on the same leaf with the mine and eaten patches.

Specimens occur in which the markings are obscure and not lustrous in the male; such specimens, if reared, can definitely be assigned to *trifasciella* by characters of the cocoon—its shape and number of ridges, and often by its gray color.

This species is closely allied to *B. quinquenotella* Chambers, but in *quinquenotella* the markings are silvery in both sexes, and a fifth silvery spot is present basad of the patch of raised scales. Other points of differentiation are enumerated under *quinquenotella*.

(72) ***Bucculatrix quinquenotella*** Chambers (Figs. 187, 188, 189.)

1875. *Bucculatrix quinquenotella* Chambers, Cin. Quart. Journ. Sci. II: 120.
Type locality, Kentucky. (Type not in existence.)

Face whitish ochereous, tuft reddish ochereous to brownish ochereous; eye-caps white, scarcely tinged with pale ochereous, antennal stalk annulate with brown. Thorax brownish ochereous, tegulae and extreme base of fore wing pale whitish ochereous. Fore wings pale ochereous to dark brownish ochereous, marks brilliant silvery, more or less iridescent in both sexes. Three oblique and equally spaced silvery marks from costa; the first passes obliquely across the wing to dorsal margin just basad of the patch of raised scales and is broken on the fold; the second, from just before middle of costa, shorter and narrower than the first, does not reach the middle of the wing; the third, at two-thirds of costa, points toward tornus, its apex a little beyond a larger triangular spot on dorsum near tornus; a black apical spot containing a few raised scales is margined inwardly by a narrow curved silvery iridescent streak, not reaching either margin; the large patch of black raised scales at middle of dorsum lies just within the dorsal margin and attains the fold, the ground color deepened by dark-tipped scales

between it and the silvery spot near tornus; a few raised black scales (easily lost) on termen just above tornus; a line of black-tipped scales at the base of the cilia curving around apex and continuing to tornus, is connected at apex to the black apical spot by the raised scales. Hind wings and cilia pale brownish or reddish ochereous to dark fuscous. Legs pale ochereous, shaded with fuscous in the darkest specimens only. Abdomen pale ochereous, sometimes darkened above with dark fuscous shading.

Alar expanse 7 to 8 mm.

Male genitalia (fig. 188). Very similar to *trifasciella*, except that the harpes are larger and broader and exceed the socii, the latter not widely separated, and the aedeagus scarcely bulges before the acuminate apex; an elongate group of minute cornuti present. Scale sac large.

Female genitalia (fig. 187). Sternite of segment 7 sculptured, the lobes fringed with long scales, scales of posterior dorsal margin of 7 shorter; on inter-segmental membrane and ventral to ostium, a curved row of very small scales; on each side of sternite of 8, an elongate patch of specialized scales; at anterior margin of tergite of 8, a double row of small specialized scales; margin of ostium with two outwardly directed acutely pointed processes; signum as in *trifasciella*.

Specimens examined.—67, ♂, ♀.

KENTUCKY: Red Bird River, Clay County, 1 ♀, imago VII.13.33 (A. F. Braun) [A.F.B.Coll.].

OHIO: Adams County, 1 ♀, June 30, 1928 (A. F. Braun) [A.F.B.Coll.].

MICHIGAN: Bath, Clinton County, 1 ♂, May 26, 1957 (R. W. Hodges) [Cornell U.].

MISSOURI: 2 ♂, 1 ♀ (Murtfeldt Coll.) [Cornell U.].

IOWA: Iowa City, 2 ♂, 6 ♀, July 2, 1918 (A. W. Lindsey) [U.S.N.M.]; 1 ♀, July 2, 1918 (A. W. Lindsey) [A.F.B.Coll.].

TENNESSEE: Monteagle, 1 ♂, 1 ♀, June 28, July 2 (Richards) [Cornell U.].

GEORGIA: Neel Gap, 1 ♀, June 25, 1946 (P. W. Fattig) [U.S.N.M.].

SOUTH CAROLINA: Cherry Hill Recreation Area, Rte. 107, Oconee County, 2000 feet, 3 ♂, Aug. 7 to 11, 1 ♂, Sept. 4, 1 ♀, Aug. 11, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

NORTH CAROLINA: Highlands, Macon County, 3865 feet, 23, ♂, ♀, July 5 to August 20, 1958, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

DISTRICT OF COLUMBIA: Washington, 1 ♀, June 1, 1901, (Aug. Busck) [U.S.N.M.].

NEW JERSEY: Lakehurst, 2 ♀, July 4, 1907 (W. D. Kearfott) [U.S.N.M.].

NEW YORK: Monroe County, 8 ♀, 1 ♂ (some in poor condition), May 14 to July 23 (C. P. Kimball) [C.P.K.Coll.].

MASSACHUSETTS: Barnstable, 1 ♂, 2 ♀, July 6, 10, August 15 (C. P. Kimball) [C.P.K.Coll.].

NEW HAMPSHIRE: Center Harbor, 1 ♀ (Collection H. G. Dyar) [U.S.N.M.].

ONTARIO: Smoky Falls, Mattagami R., 1 ♀, 19.VI.34 (G. S. Walley) [C.N.Coll.]; Sparrow Lake, 2 ♂, July 12, 14 (A. F. Braun) [A.F.B.Coll.].

QUEBEC: Marks, 3 ♂, 1 ♀, 29.VI.1933 (G. S. Walley) [C.N.Coll.].

NOVA SCOTIA: Halifax, 3 ♂, 1 ♀, "Bred ex larva, Food oak" [*Quercus rubra* L.], March 2, 3, 1951 (J. McDunnough) [Nova Scotia Museum of Science].

Chambers' unusually accurate description has assured recognition of this species.

Except for the Nova Scotia specimens I have seen no reared material, and no data on the larval habits are available. The cocoons (of the Nova Scotia specimens) are pale brown in color, and very similar to those of *B. trifasciella*, agreeing with that species in the tendency to fusion and anastomosis of the ridges.

Bucculatrix quinquenotella is closely allied to *B. trifasciella*, from which it differs in the brilliant luster of the marks in both sexes, with an additional silvery spot on dorsum basad of the raised scales, and the position of the ciliary line, connected to the apical spot in *quinquenotella*, separated from it in *trifasciella*. The Nova Scotia specimens and some of the North Carolina specimens display the dark brownish ocherous color of the fore wings; in genitalia these agree with the paler specimens. Pale specimens with spots scarcely shining also occur. Specimens in poor condition may be separated from *trifasciella* by differences in genitalia, especially of females.

To conserve the high luster of the marks, specimens should be mounted when fresh. Marks are considerably dimmed in relaxed specimens.

(73) ***Bucculatrix domicola*** new species

(Figs. 38, 39, 40, 54, 54a, 54b, 54c, 190, 191, 191a.)

Face creamy white, tuft ocherous anteriorly and laterally, brown posteriorly; eye-caps creamy white, scales rarely minutely dark-tipped, antennal stalk annulate with dark brown. Thorax pale ocherous to brownish ocherous, scales rarely dark-tipped, extreme base of fore wing pale when the thorax is pale. Fore wings brownish ocherous, darkest in the costal area between the silvery streaks and on dorsum, especially between the patch of raised scales and tornus. Marks silvery iridescent in both sexes, but sometimes so encroached upon by the brownish scales of the ground color as to be reduced to mere silvery lines,

or sometimes ill-defined and not silvery; three parallel and equidistant oblique costal streaks, the first from basal fourth, the second near middle, the third, at two-thirds of costa, meets or nearly meets at an angle in the middle of the wing a similar slender dorsal streak from just before tornus; a few silvery scales precede the black apical spot in which there are a few raised scales; a large patch of dark brown raised scales on middle of dorsum, extending to fold; often a quadrate patch of paler ground color basad of the patch of raised scales; a few raised scales at tornus; a faint line of dark-tipped scales extends from the apical spot along termen near the base of the apical cilia; a second line of dark brown-tipped scales curves around apex and extends to tornus, lying closely parallel to the first; cilia varying from ochereous to pale fuscous, darker at tornus. Hind wings and cilia fuscous, darker in males. Legs ochereous, fuscous outwardly, tarsal segments dark-tipped. Abdomen grayish ochereous below, dark fuscous above.

Alar expanse 7 to 7.5 mm.

Male genitalia (fig. 190). Harpes typical of the section, nearly attaining the socii, setose outwardly and sparsely setose inwardly, terminating in a small pointed process, a small basal process present; socii short, broad and widely separated, the sinus between them shallow; aedeagus gradually tapering to the narrow acute tip; vinculum a very narrow band. Scale sac large, scales slender.

Female genitalia (figs. 191, 191a). Fringing scales of the posterior margins of segment 7 long and slender, lobes of sternite of 7 sculptured; on intersegmental membrane near posterior ventral margin of 7, an arc of specialized scales of moderate length; posterior to ostium (but anterior to the arc) a median dense patch of small specialized scales; on the anterior margin of tergite of 8, a mass of minute scales; margin of ostium sclerotized, with two outwardly directed acutely pointed processes; signum ribs with spines grading from long acute to minute short.

Type.—♂, Cincinnati, Ohio, rearing record B.2219, with cocoon, imago August 19, 1955 (A. F. Braun) [A.F.B.Coll.].

Allotype.—♀, Cincinnati, Ohio, rearing record B.2219, with cocoon, imago August 19, 1955 (A. F. Braun) [A.F.B.Coll.].

Paratypes.—2 ♂, Cincinnati, Ohio, March 2; 2 ♂, 4 ♀, Cincinnati, Ohio, rearing record B.2219, imagoes April 23; 1 ♀, with cocoon, imago June 29; 4 ♂, 2 ♀, rearing record B.2219, imagoes July 4, July 5; 12 ♂, 6 ♀, with cocoons, rearing record B.2219, imagoes August 10 to September 2 (A. F. Braun) [A.F.B.Coll.]; 1 ♂, New Lisbon, New Jersey, June 2, 1940, emerging from cocoon on underside of a leaf (E. P. Darlington) [A.N.S.P.]; 1 ♂, Monroe County, New York, May 19 (C. P. Kimball) [C.P.K.Coll.].

In addition to the specimens listed above, one cocoon was collected August 11, near West Union, Adams County, Ohio.

The specimens of the type series from Cincinnati emerged from cocoons spun by larvae feeding on leaves high up in trees of *Quercus palustris* Muenchh., and *Quercus shumardii* Buckl. The egg is deposited on the upper side of the leaf against the midrib or a lateral vein. The mine (figs. 54a, 54b) is short, somewhat contorted, thus differing from that of *B. packardella* often occurring on the same trees with this species. The larva commonly, in the June and later summer generations, descends to the ground by a silken thread, spinning its cocoon on any convenient surface. The cocoon (fig. 54c) is pale whitish stramineous, slender, elongate, with six or seven prominent ridges.

Three generations a year have been observed and specimens reared at Cincinnati; moths emerge from overwintering pupae from early March to late April; the larvae of a second generation become full-fed and pupate about mid-June, the imagoes emerging the last of June and early July; a third generation pupates early in August, imagoes emerging in August and early September; larvae from eggs laid by this generation become full-fed and pupate in late September or October.

Bucculatrix domicola is allied to both *B. trifasciella* and *B. quinquenotella*, and males may be mistaken for small males of *trifasciella*; from *quinquenotella* it is at once distinguished by the less conspicuous silvery streaks and the absence of a silvery spot basad of the raised scales. This species often occurs together with *packardella*; worn or pale specimens with obscure markings may be distinguished from that species by the darker hind wings and dark fuscous upper side of the abdomen.

The more slender tapering aedeagus of the male, and the mass of minute specialized scales on the dorsal anterior margin of segment 8 in the female are the most distinctive characters of the genitalia. From all other oak-feeding species it is separated by the slender few-ribbed cocoon.

(74) ***Bucculatrix zophopasta*** new species (Figs. 192, 193, 194, 194a.)

Face white, tuft on vertex dark ochereous or dark fuscous; eye-caps white, antennal stalk annulate with dark brown. Thorax ochereous or irrorated dark fuscous. Fore wings (in the reared Oregon series and in the California series) ochereous, the scales shading to brown at their tips, or (in the Vancouver Island series) irrorated dark fuscous, with an angulated white fascia near base and two oblique costal streaks; extreme base of wing pale; the angulated fascia is oblique

from basal fourth of wing to fold, where sometimes slightly interrupted by ground color, and here angulated and perpendicular to the dorsal margin which it attains before the middle immediately basad of the large patch of black raised scales; this band may be produced as a white or pale ochereous shade through the middle of the wing; from middle and two-thirds of costa, less oblique streaks, in dark specimens somewhat obscured by encroachment of the fuscous scales; the second of these attains the termen above tornus; a transverse white bar across apex at the base of the cilia; cilia whitish or pale fuscous, with a ciliary line of black-tipped or dark brown-tipped scales, which in pale specimens becomes obsolete before tornus. Hind wings in the paler specimens pale stramineous in female, pale fuscous in male, in dark specimens pale fuscous in both sexes. Legs pale stramineous, shaded with fuscous, tarsal segments broadly tipped with fuscous. Abdomen dark fuscous above, whitish beneath.

Alar expanse 7 to 8 mm.

Male genitalia (figs. 192, 193). Harpes setose outwardly, sparsely setose inwardly, terminating near inner margin of apex in a small pointed process, basal process present; socii short, broad, setose, tegumen sclerotized in a narrow band between them; aedeagus curving near tip and tapering to the acutely pointed tip; vinculum a very narrow band. Scale sac with rather short, rounded scales.

Female genitalia (figs. 194, 194a). Lobes of sternite of 7 sculptured, fringing specialized scales of posterior margins long and narrow; mid-ventrally on intersegmental membrane a patch of short specialized scales; on anterior margin of tergite of 8, a short curved group of curved specialized scales, and anterior to it on the intersegmental membrane, a mass of small scales; ostium funnel-shaped, shallowly indented mid-ventrally, sclerotized; signum ring obsolescent dorsally, spines of signum ribs acicular, of uneven length.

Type.—♂, Hood River, Oregon, "Reared from *Quercus garryana*, em. 9.VII.51" (V. W. Olney) [U.S.N.M., Type No. 65033].

Allotype.—♀, Hood River, Oregon, "Reared from *Quercus garryana*, em. 11.VII.51" (V. W. Olney) [U.S.N.M.].

Paratypes.—3 ♂, 6 ♀, same data as the type and allotype [U.S.N.M.]; 4 ♂, 7 ♀, Victoria, British Columbia, May 5 to May 14 and June 16 to 22 (W. R. Carter) [U.S.N.M.]; 1 ♀, Victoria, British Columbia, 8.VI.1920 (W. Downes) [C.N.Coll.]; 1 ♀, Victoria, British Columbia, 14.VI.23 (E. H. Blackmore) [A.F.B.Coll.]; 3 ♂, 1 ♀, Mineral King, Tulare County, California, June 17, June 24–30, and July 16–23 [U.S.N.M.].

All of the reared series and the California series are pale; all of the Victoria, British Columbia specimens are irrorated dark fuscous; genitalia slides have demonstrated the specific identity of the two series. The species is distinct in wing markings and in genitalic characters.

The food plant of the British Columbia and Oregon specimens, *Quercus garryana* Dougl., is confined to the northern Pacific coastal region and valleys of western Washington and Oregon; the food plant of the California series (from the foot hills of the Sierras) may possibly be *Quercus lobata* Née.

(75) *Bucculatrix litigiosella* Zeller (Figs. 195, 195a.)

1875. *Bucculatrix litigiosella* Zeller, Verh. zool.-bot. Ges. Wien XXV: 354. Type ♀, bearing the following labels: (1) White label with "Dallas, Tex. Boll" printed, (2) Green (typical) Zeller label with "*Bucculatrix litigiosella* Z.," (3) Small white label with "Zeller" printed on it, (4) Red "Type" 14959, (5) ♀ genitalia slide 29.X.1957, J.F.G.C. No. 10655. Dallas, Texas [M.C.Z., Type No. 14959].

The following description of the type is compiled from Zeller's description, supplemented by notes and a sketch of the type at Cambridge:

Tuft pale ochereous, browner centrally; antennae annulate with fuscous. Fore wings pale ochereous, markings a shade darker, with tips of scales brown; costa to one-third with dark-tipped scales; "the first costal spot" near base, becomes obsolescent below costa; the second before middle is short, both first and second costal spots lightly dusted, the second separated from the third costal spot by the pale ground color; the third costal spot, darker than the first two and the most conspicuous costal mark, is broad on costa and curves to the middle of the wing; the fourth costal mark is pale, lightly dusted on costa, directed toward termen, and becoming obsolete; on dorsal margin beyond middle, a large patch of dark brown scales, followed toward tornus by paler dark-tipped scales (concolorous with those of the third costal spot); a few dark-tipped scales on dorsum near base, along termen, and at apex; a line of black-tipped scales encircling the apex in the pale ochereous cilia. Hind wings and cilia pale gray. Abdomen pale dusty gray, underside and anal tuft pale ocher yellow.

In the above description, I have followed Zeller in regarding the pale areas as ground color and the areas of dark-tipped scales as the markings, rather than the reverse, as in the descriptions of all other species of the section.

Female genitalia (figs. 195, 195a). Typical of the section; minute sockets at the anterior margin of tergite of 8 indicate a group of specialized scales (lost on the slide); no other patches of specialized scales visible on the slide; if any were present on the intersegmental membrane, these were lost in the preparation of the slide; lobes of sternite of segment 7 sculptured; ostium rounded, margin laterally with minute sclerotized points; signum the typical ring of spined ribs, ribs irregularly spined with long and short acute spines (fig. 195a).

Only the female type from Texas has been examined. Zeller in his description of the species states "Zwei ♂ im Museum Cambridge"; Dr. Clarke at the time of making the slide found but one specimen and this a female, from which the slide was made and here figured.

Food plant unknown, but probably a species of *Quercus*.

Zeller compares his specimens with the European *B. ulmella* Zeller; this suggests the possibility of its identity with the elm-feeding species of the Northeast, which is at once separated from *litigiosella* by the very different and characteristic genitalia (cf. fig. 223).

Forbes (1923, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 158) identified as *litigiosella* a small species (6 mm.) on white oak. I have examined this specimen and it is an example of *recognita* new species, and is included among the paratypes of that species.

(76) ***Bucculatrix coronatella*** Clemens (Figs. 20, 196, 197.)

1860. *Bucculatrix coronatella* Clemens, Proc. Acad. Nat. Sci. Phila.: 13. Type locality, Pennsylvania (? Easton). Type not in existence.

1872. *Bucculatrix coronatella* Stainton, Tin. No. Amer., pp. 108, 109.

1873. *Bucculatrix coronatella* Chambers, Canad. Ent. V: 151.

1903. *Bucculatrix coronatella* Busck, Proc. Ent. Soc. Wash. V: 198.

1923. *Bucculatrix coronatella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 158.

Head yellowish white, tuft orange-ocherous centrally, eye-caps yellowish white tinged with ocherous posteriorly, antennal stalk dotted with brown above. Thorax orange-ocherous, tegulae and extreme base of fore wing pale. Ground color of fore wings a uniform orange-ocherous or sometimes brownish; at basal fifth, above the fold, an oblique whitish spot, narrowly separated from the costal margin by ground color; on the dorsum, opposite its apex, a second whitish spot, followed by a patch of black raised scales, which may be conspicuous, extending from dorsum to fold, reduced to a few scales, or sometimes absent; ground color behind the raised scales not darkened; near middle of costa an oblique whitish streak; at two-thirds, an irregular whitish band, angulated at its middle, crosses the wing to tornus; an apical whitish patch before the small black apical spot may extend into cilia of costa and termen, thus encircling it; a line of black-tipped scales in the cilia opposite apex continues to tornus, sometimes merely as a faint pale line; a few of the marginal scales along termen, especially near tornus, often black-tipped; cilia whitish or pale ocherous, tinged with fuscous toward dorsum. Hind wings and cilia gray or pale reddish fuscous. Legs pale stramineous, hind tarsal segments faintly dark-tipped. Abdomen stramineous below, fuscous and reddish brown above.

Alar expanse 7.5 to 8 mm.

Male genitalia (fig. 197). Harpes typical of the section, setose outwardly, terminating at apex in a small pointed process, basal process present; socii short, broad, setose; aedeagus stout, tapering to the acutely pointed tip; vinculum a very narrow sclerotized band. Scales of scale sac long and slender.

Female genitalia (figs. 196, 196a). Dorsal posterior margin of segment 7 fringed with specialized scales, the ventral posterior margin fringed laterally only with long specialized scales; on intersegmental membrane and ventral to ostium, a dense tuft of specialized scales on each side of mid-ventral line, connected by less closely placed scales; on sternite of 8, on each side of ostium, a large elongate patch of dark specialized scales; on anterior margin of tergite of 8, a row of very small scales; ostium ventrally with narrow lobed, dorsally broadly lobed sclerotization; signum ribs irregularly spined, with some long acicular spines.

Specimens examined.—17 ♂, 19 ♀.

DISTRICT OF COLUMBIA: Washington, 1 ♂, "on birch," iss. 19 July, 1894; 1 ♂, July 1, 1902; 1 ♂, "coll. on birch" May 11, 1901 (A. Busck) [U.S.N.M.]; 1 ♂, May 20, 1885 (Koebele Collection) [A.F.B.Coll.]. Without locality, but probably from the vicinity of Washington, D. C.: 5 ♂, 12 ♀, "on black birch," some with cocoons, May 6 to May 11, 1885, March 24, 1884, January 11, 1884 (C. V. Riley Coll.) [U.S.N.M.].

VIRGINIA: Falls Church, 1 ♂, 2 ♀, May 11, June, 1903 (August Busck) [U.S.N.M.].

NEW JERSEY: New Lisbon, 3 ♂, 1 ♀, July 7, 1942 (E. P. Darlington) [A.N.S.P.].

PENNSYLVANIA: Floradale, Adams County, 2 ♂, 2 ♀, with cocoons, July and August, 1917 [J. R. Eyer Coll.].

ONTARIO: Ottawa, 1 ♀, June 27, 1934 (C. H. Young) [C.N.Coll.]; Bobcaygeon, 1 ♀, June 23 (J. McDunnough) [C.N.Coll.].

OHIO: Blue Creek, Adams County, 2 ♂, rearing record B.2282, on *Betula nigra* L. (river birch), imagoes July 18, July 22, 1958 (A. F. Braun) [A.F.B. Coll.].

KENTUCKY: Along Triplett Creek, Morehead, Rowan County, rearing record B.2283 on *Betula nigra* L., larvae only, July 9, no imagoes reared.

The following notes on the life history of this species are based on the material reared on *Betula nigra* L. in Adams County, Ohio.

The egg is deposited on the underside of the leaf against a vein—usually a lateral vein—and is marked with the typical hexagonal sculpturing. The very fine thread-like, irregularly winding mine, usually not over a centimeter in length, but sometimes 1.5 cm. long, is filled with blackish frass. Moulting cocoons, the first and second similar except for size, are spun on the upper side of the leaf of closely woven

fine silk, so thin as to be almost transparent, with the larva curled within or the cast skin plainly visible as a whitish spot. External feeding takes place commonly on the underside of the leaf. Mature larva pale green with reddish tinge on thoracic segments and head. Cocoon pale to brownish ochereous, with seven or eight ridges, of which five or six are well-defined; in several of the Pennsylvania examples, the ridges are somewhat diagonally placed, with resulting anastomosis and fusion.

Larvae were collected on June 30 in first and second moulting cocoons; the last instar larva feeds for only a few days before spinning; first cocoon spun July 4.

The food plant of the Washington specimens, labeled "black birch," is probably *Betula nigra* L. *Betula nigra* has sometimes been called "black birch" (see Little, Check List of Native and Naturalized Trees of the United States, 1953).

Clemens' type is not in existence and our conception of the species is based on the series reared on "black birch." Busck (1903, *l.c.*) states "In the U. S. National Museum is a large series bred from black birch and determined as this species. As it agrees with Clemens' description and very likely was compared with Clemens' type, this series may properly be regarded as representing *B. coronatella*."

In the fore wing (fig. 20) cubitus is obsolete beyond the cell, its course beyond this point merely indicated by a slight difference in the wing surface. Clemens (*l.c.*, p. 108) noted this character under the generic description preceding the species description.

The uniform ground color of the fore wings without darkening behind the raised scales (as in the related oak-feeding species), the black raised scales, black apical spot and black apical ciliary line forming the only dark marks, distinguish this species. The unusual position of the moulting cocoons—on the upper side of the leaf—is characteristic.

(77) ***Bucculatrix canadensisella*** Chambers (Figs. 34, 176, 198, 199, 199a.)

1875. *Bucculatrix canadensisella* Chambers, Canad. Ent. VII: 146. Type ♀, "N. S." (? Nova Scotia) [U.S.N.M., Type No. 5775]. [A "type" also in M.C.Z.]

1923. *Bucculatrix canadensisella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 158.

1927. The Biology of the Birch Leaf Skeletonizer, *Bucculatrix canadensisella*, Chambers. Friend, Roger B., Conn. Agric. Exp. Sta. Bull. 288. (A detailed treatment, with map of distribution and extensive bibliography.)

Face whitish, more or less brownish tinged, tuft white, centrally brown; eye-caps white, antennal stalk with narrow brown annulations. Thorax brown, tegulae white, the white sometimes spreading to cover all but a narrow mid-dorsal stripe. Base of wing white, the white color sometimes spreading outwardly below fold, and rarely confluent with the white dorsal spot; ground color of the fore wing dark brown, reddish brown, or sometimes paler fuscous and then more or less irrorated; from basal fifth of costa an oblique streak, broadest on costa, sometimes meeting the white oblique dorsal spot placed before middle of dorsum, but more often separated from it by ground color; a patch of black raised scales borders the dorsal spot posteriorly; just before middle of costa and at three-fourths, oblique white streaks, the second the longer; a little anterior to the second of these, a less oblique dorsal streak; near apex a white mark, widest on costa, curves to termen, enclosing the black apical spot; a line of black-tipped scales curves around the black apical spot from the white costal mark to tornus, the scales less broadly black-tipped toward tornus; cilia reddish tinged. Hind wings gray, the cilia brownish or reddish tinged. Legs brown outwardly, tarsal segments broadly brown-tipped. Abdomen silvery white beneath.

Alar expanse 7 to 8.5 mm.

Male genitalia (fig. 198). Harpes typical of the section, setose outwardly, terminating at apex in a small pointed process, a small basal process; socii short, broad, setose, sinus between them shallow; aedeagus stout, tapering to the acutely pointed tip; vinculum a very narrow sclerotized band. Scales of scale sac of two kinds, slender and pointed and broadly oval.

Female genitalia (figs. 199, 199a). Both dorsal and ventral posterior margins of segment 7 fringed with long specialized scales; on the intersegmental membrane and ventral to ostium, a dense tuft of specialized scales on each side of mid-ventral line; on sternite of segment 8, on each side of ostium, a large dense patch composed of several rows of specialized scales; on anterior margin of tergite of 8, a row of very small scales, emarginate mid-dorsally; margin of ostium sclerotized, with two outwardly directed acute processes; signum ribs with long spines posteriorly, grading anteriorly to short acute spines.

Some 150 specimens, including the types, and representing both sexes, have been examined in the collections of the United States National Museum, Academy of Natural Sciences of Philadelphia, Canadian National Collection, in my own collection, and in other collections.

Friend (*l.c.*) has mapped the distribution of this very common species, basing his map on records available to him at that time (1927). As shown on his map and referred to in the text, *B. canadensisella* occurs in the Canadian provinces from New Brunswick to British Columbia; to these records I add Nova Scotia and Prince Edward Island

[C.N.Coll.]. His records include stations in the New England States, New York, Michigan, Wisconsin and Minnesota; it is also recorded [A.N.S.P.] from Hazleton, Pennsylvania "bred from *Betula nigra*" and from New Jersey, Whitesbog. The southern record from North Carolina is based on two females reared from *Betula lutea* Michx. f., Eagle's Nest, altitude 5000 feet [A.F.B.Coll.]. In addition, mines have been observed, but no moths reared, on *Betula lutea* on the Appalachian Trail, near Newfound Gap, Great Smoky Mountains, Tennessee at an altitude of approximately 5000 feet, and on the summit of Big Black Mountain, Kentucky, altitude 4000 feet; that is, it may apparently be found along the higher summits of the Southern Appalachians. To these, I add a disjunct occurrence of the species from Colorado: Moraine Park, Rocky Mountain National Park, 2 ♂, reared on *Betula occidentalis* Hook. [A.F.B.Coll.].

The mine is a very narrow and contorted linear mine, 15 to 20 mm. in length; in the last two instars the larvae feed externally, skeletonizing the leaves, but leaving the upper epidermis intact. Feeding normally takes place on the underside of the leaf; however, in the North Carolina and in the Colorado specimens, larvae fed on the upper surface of the leaf. Recorded food plants in the East include *Betula populifolia* Marsh., *B. papyrifera* Marsh. (across Canada), *B. lutea* Michx.f., *B. lenta* L., *B. nigra* L. and the European *B. alba* L.; in Colorado, *B. occidentalis* Hook. The brown cocoon is rather short and rounded at both ends, with five or six prominent ridges. There is apparently but one generation a year. The depredations of the larvae have been the subject of a number of economic papers.

Bucculatrix canadensisella is allied to *B. coronatella*, agreeing with it in configuration of markings, but at once separated from that species by the dark brown or fuscous color of the fore wings.

(78) ***Bucculatrix improvisa*** new species (Figs. 200, 200a, 201.)

Face pale straw-colored, tuft pale ochreous, usually brown centrally; eye-caps pale straw-colored, with a few brownish speckles, antennal stalk conspicuously annulate with dark brown. Thorax and fore wings golden brown or ochreous, the scales mostly tipped with dark brown, sometimes very narrowly; the immediate base of wing paler; a streak along fold sometimes orange-tinted; at basal fourth, and separated from the costal margin by brown-tipped scales, is

a pale roundish spot nearly reaching the fold, this spot often more or less dusted with brown-tipped scales of the ground color, and sometimes obliterated; just before middle of costa, an oblique pale streak; at two-thirds of costa, a second but narrower oblique pale streak, which may meet, at a very obtuse angle or even lie in line with, a faint pale spot or streak at tornus; between these two costal streaks the ground color is darkened; a pale spot precedes an irregular group of black-tipped scales at apex, some of which project irregularly into the cilia and may touch a line of black-tipped scales opposite apex; on middle of dorsum, a large patch of black or dark brown-tipped raised scales, with an ill-defined pale patch basad of it; between the raised scales and the pale streak at tornus, the ground color is darkened, the scales sometimes broadly brown- or blackish-tipped; the area beyond the pale tornal streak is usually of a more uniform golden ochereous color, and the slender scales projecting from it into the cilia of termen are pale brown-tipped, the outer line of these scales meeting the line of black-tipped scales opposite apex with a strong contrast. Hind wings and cilia fuscous, in the male the apex of the wing considerably darker and somewhat irrorated. Legs grayish straw-colored, the tarsal segments darker at tips. Abdomen dark fuscous above, pale beneath.

Alar expanse 7 to 7.5 mm.

Male genitalia (fig. 201). Harpes typical of the section, but very slender and parallel-sided, rounded at apices; socii bent inwardly, thus appearing narrow and acute, when flattened, broad and rounded; aedeagus elongate, tapering to the acuminate apex; vinculum a very narrow band, posteriorly curving mid-ventrally. Scale sac large, nearly globular.

Female genitalia (figs. 200, 200a). Fringing specialized scales of posterior margins of segment 7 short, only half as long as the normal scales overlying them; on each side of ostium on sternite of 8, a large patch of specialized scales, made up of innumerable small, pointed, heavily pigmented scales; at anterior margin of tergite of 8, a long double row of minute specialized scales; margins of ostium outcurved; bursa copulatrix very small, signum occupying one-half its length, ribs closely placed, each becoming attenuated and ending in a series of minute spines and knobs (fig. 200a).

Type.—♂, Fort Ancient State Memorial, Warren County, Ohio, rearing record B.2284 (larva on *Tilia americana* L.), imago in early July (A. F. Braun) [A.F.B.Coll.].

Allotype.—♀, same data as the type.

Paratypes.—3 ♂, 3 ♀, same data as the type; 1 ♂, imago July 9.

Food plant, *Tilia americana* L.; rarely mines occur on *Tilia neglecta* Spach and on *T. heterophylla* Vent.

The egg is laid on the upper side of a leaf against a vein; the mine is a fine thread lying at first alongside the vein for 8–10 mm., then sharply diverging from it for about 2 mm.; on thin leaves the mine may

be 20–25 mm. long, with the section diverging from the vein 4–5 mm. long and sometimes winding. After leaving the mine, the leaf is eaten in patches, leaving the upper epidermis. Both first and second moulting cocoons white. The fifth instar larva is greenish red, with tubercles white and strongly contrasting. The cocoons of the early summer generation, spun by larvae becoming full-fed in mid-June, are to be found on the underside (sometimes on the upper side) of leaves of the food plant; they are usually yellowish, anterior and posterior ends bright orange or reddish orange, and sides (in contact with the leaf) narrowly reddish orange, with the reddish color sometimes spreading over the whole anterior section of the cocoon; occasionally cocoons are of a paler brownish ochereous color; the even, regular ridges are few in number, not over six and sometimes fewer distinct.

Two generations a year; larvae of the first generation, full-fed in June, produce imagoes in early July; a second generation, with larvae in late August or early September, passes the winter in the pupal state.

Bucculatrix improvisa may best be identified by genitalia, which are distinctive in both sexes; in the male the slender harpes and acuminate aedeagus, in the female the large patches of minute specialized scales on sternite of 8 separate this species from others of the section. In wing markings, the pale spot (not the usual pale streak common to related species) below costa at one-fourth the wing length, and the pale brown-tipped scales at tornus and termen, sometimes with a ragged effect, may be of some aid in identification. It somewhat resembles pale, lusterless examples of *B. trifasciella*.

(79) ***Bucculatrix polytita*** new species

(Figs. 202, 202a, 203.)

Head pale buff, tuft with brown and ochereous scales intermixed; eye-caps pale, antennal stalk dark brown above, with narrow pale annulations, pale beneath. Thorax pale buff, brown mid-dorsally. Base of fore wing pale buff, followed by a band of fuscous-tipped ochereous or dark fuscous scales; this band is outwardly angulated on the fold and is followed by a broad pale buff band more or less distinctly outwardly angulated; the middle third of the wing is occupied by a broad dark band, into which a pale oblique costal streak projects; this band is broadest on costa and its outer margin is angulated in the middle of the wing; in this band the scales vary from fuscous-tipped ochereous to blackish fuscous, the darkest color usually in the outer costal area beyond the pale streak and below fold; a patch of black raised scales borders its inner margin on dorsum; the pale costal streak is nearer to the proximal than to the distal border of the dark band; the dark band is bordered outwardly by a pair of buff

streaks; wing beyond this pair of streaks usually pale and when thus, the pair of streaks not sharply defined; wing before apex creamy white, the white often encroached upon in darker specimens by fuscous-tipped scales; a few black scales form an apical spot; opposite it in the cilia a very short line of black scales, which only in the darkest specimens is continued as a faint line toward tornus; cilia whitish to reddish ochereous. Hind wings varying from whitish ochereous in females to dark fuscous in the darkest males. Legs pale buff, tips of tarsal segments darker. Abdomen buff (female) to silvery gray (male) beneath, brownish ochereous (female) to dark fuscous (male) above.

Alar expanse 7 to 7.5 mm.

Male genitalia (fig. 203). Harpes typical of the section, setose outwardly, with broad evenly rounded apex, and basal process; socii short, broad, sinus between them shallow, some long setae among the short setae; anellus with strongly sclerotized lateral arms; aedeagus stout, slightly bulging before tapering to the acute apex; vinculum a very narrow sclerotized band. Scale sac large, with long scales.

Female genitalia (figs. 202, 202a). Dorsal posterior margin of segment 7 fringed with short specialized scales, its ventral posterior margin, except mid-ventrally, fringed with specialized scales and at the lateral margin of the sternum a tuft of long slender scales; on the intersegmental membrane, ventral to ostium, a half circle of specialized, rather broad scales; on each side of ostium on sternite of 8, a large patch of specialized scales, each composed of an anterior half of pale scales, overlying the bases of a dark-pigmented group of slender scales; on the anterior margin of tergite of 8, a short line of very small dark specialized scales; margin of ostium sinuate; signum the usual ring of spined ribs, ventrally with an occasional short rib lying between the anterior ends of two long ribs, spining irregular (fig. 202a).

Type.—♂, Bobcaygeon, Ontario, 17.VI.'31, "swept from Tilia" (J. McDunnough) [C.N.Coll., Type No. 7176].

Allotype.—♀, Bobcaygeon, Ontario, 17.VI.'31 (J. McDunnough) [C.N.Coll., Type No. 7176].

Paratypes.—1 ♂, 3 ♀, Bobcaygeon, Ontario, June 17 to June 29 (J. McDunnough) [C.N.Coll.]; 5 ♀, Tweed, Ontario, 6.VII.1944, "on soft maple" (G. S. Walley) [C.N.Coll.]; 1 ♀, Maitland, Ontario, 30.VI.'31 (L. J. Milne) [C.N.Coll.]; 2 ♂, Pt. Pelee, Ontario, 17.VI.1927 (F. P. Ide) [C.N.Coll.]; 1 ♂, Sparrow Lake, Ontario, July 12, 1926 (A. F. Braun) [A.F.B.Coll.]; 1 ♂, 2 ♀, Hull, Quebec, 20.VI.1955 (T. N. Freeman and G. G. Lewis) [C.N.Coll.]; 1 ♂, Dechenes, Quebec, 23.VI.1933 (G. S. Walley) [C.N.Coll.].

Food plant not known with certainty; the records "swept from Tilia" and "on soft maple" are not conclusive. Probably either one of these may prove to be the food plant.

The distinctive characteristics of the wing markings of this species are the buff color of the pale markings, the broad pale band near base, the dark median area of the wing usually contrasting with the pale outer third, and especially the position of the pale oblique costal streak, which is noticeably nearer to the broad pale buff band than it is to the pale costal streak bordering the dark median area distally. In dark specimens (lacking the contrast between median and apical areas) the last is the best diagnostic character. In pale specimens, with expansion of pale areas, this streak may be nearly confluent with the pale band. Genitalia are distinctive; in the male the broad even curve of the apex of harpe separates this species from all allied species; in the female the two kinds of scales forming the specialized scale patches lateral to ostium, and the slender scales at the lateral margins of sternum of segment 7 are diagnostic.

(80) *Bucculatrix luteella* Chambers (Figs. 207, 207a, 207b, 208, 208a.)

1873. *Bucculatrix luteella* Chambers, Canad. Ent. V: 151. Type ♀, Kentucky [U.S.N.M., Type No. 520]. In Museum of Comparative Zoology, is a series of specimens, all marked type, of which only a few are *B. luteella*, the others are *B. packardella*. A male "Type" in the Academy of Natural Sciences of Philadelphia represents this species.

1879. *Bucculatrix luteella* Chambers, Canad. Ent. XI: 93.

1923. *Bucculatrix luteella* Braun, Trans. Amer. Ent. Soc. XLIX: 357.

1923. *Bucculatrix luteella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 156.

Head white, tuft white, with a few yellow hairs in darker specimens; eye-caps white, antennal stalk white, with distinct brown annulations, but in pale females with scarcely an indication of annulations. Thorax and fore wings creamy white or pale yellow; the wing color shades to pale orange in the middle of the wing, there forming the inner margin of an oblique costal streak of the pale ground color, which blends with the pale ground color below fold; on middle of dorsum a patch of dark brown raised scales, variable in size and sometimes entirely absent; beyond the oblique costal streak, the deeper color of the costal half of the wing borders a second pale streak which passes obliquely across the wing to termen; in pale specimens these two oblique streaks are scarcely differentiated; in darker specimens some of the orange scales are minutely dark-tipped; in the apical area, the scales are creamy white, yellow and pale orange intermixed; no apical spot, no ciliary line, except that in darker males there may be a slight deepening of color at the extreme tips of a few of the scales projecting into the cilia; cilia concolorous with the pale ground color.

Hind wings varying from yellowish white in some females, to pale fuscous in male. Legs creamy white. Abdomen creamy white beneath, with fuscous shading above.

Alar expanse 5 to 6 mm.

Male genitalia (figs. 207, 207a, 207b). Harpes typical of the section, short and broad, with evenly rounded apex, setose, not attaining socii, which project well beyond them; socii elongate, sinus between them deep; anellus a sclerotized ring; aedeagus long, bent beyond anellus and thence attenuated to the acute apex; vinculum largely membranous, sclerotized only along its very obtusely angulated anterior margin. Scale sac small, elongate, scales long and slender (fig. 207b).

Female genitalia (figs. 208, 208a). Posterior margins of segment 7 fringed with long specialized scales dorsally (omitted in figure) and ventrally except mid-ventrally; on intersegmental membrane near posterior margin of the seventh sternite, and posterior to ostium, a pair of small specialized scale tufts; ostium with pouch-like lateral expansion; ductus bursae sclerotized in segment 7, expanded near bursa copulatrix nearly to width of bursa; signum near posterior end of bursa, signum ribs with short, basally broad, abruptly pointed, appressed spines (fig. 208a).

Specimens examined.—16 ♂, 8 ♀, and types at the Museum of Comparative Zoology, sex not determined.

KENTUCKY: ♀ type [U.S.N.M.]; type series [M.C.Z.]; ♂ "type" [A.N.S.P.]; 1 ♀, labeled in Chambers' handwriting [U.S.N.M.]; Mammoth Cave, 1 ♀, September 9, 1940 (A. F. Braun) [A.F.B.Coll.]; 1 (wings only) [A.N.S.P.].

OHIO: Cincinnati, 1 ♂, 1 ♀, rearing record B.398, larvae on *Quercus alba* L., imagoes August 4 and August 8, 1908; 5 ♂, May 27, 1911; 1 ♀, September 1, 1920 (A. F. Braun) [A.F.B.Coll.].

IOWA: Sioux City, 2 ♂, 1939 (C. N. Ainslie) [U.S.N.M.].

NEW JERSEY: New Lisbon, 1 ♂, June 13, 1938, "bark oak," 1 ♀, "on white oak leaf," July 13, 1934 (E. P. Darlington) [A.N.S.P.].

PENNSYLVANIA: Roxboro, 1 (without antennae or abdomen), V-26 (F. Haimbach) [A.N.S.P.].

DISTRICT OF COLUMBIA: Washington, 1 ♀, 10/5,85 [U.S.N.M.]; 1 ♂, with cocoon on fragment of oak leaf, 21/7,84, "oak" [U.S.N.M.].

NORTH CAROLINA: Highlands, Macon County, 3865 feet, 5 ♂, August 1 to September 3, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

SOUTH CAROLINA: Cherry Hill Recreation Area, Rte. 107, Oconee Co., 2000 feet, 1 ♀, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

Bucculatrix luteella probably feeds on several species of oaks of the white oak group; *Quercus alba* L. is the food plant of the Ohio reared

specimens; the food plant of the Iowa specimens is probably *Q. macrocarpa* Michx. Cocoon similar to that of *packardella*, but with two or three fewer ridges.

The configuration of wing markings is the same as in *packardella*, from which it is easily distinguished by the absence of apical spot and ciliary line. In genitalia of both sexes it differs from all other described species.

(81) ***Bucculatrix recognita*** new species (Figs. 204, 204a, 205, 205a, 206.)

1923. *Bucculatrix litigiosella* Forbes (not Zeller), Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 157.

Head creamy white, tuft with a greater or less admixture of ocherous or dark brown hairs; eye-caps creamy white, conspicuously dotted with brown-tipped scales, antennal stalk annulate, each segment shading from pale buff through brownish ocherous to dark brown at tip, and an occasional paler segment near apex of antenna, antennal notch deep. Thorax including tegulae pale yellow, conspicuously dotted with brown-tipped scales or sometimes minutely dark-dotted. Fore wings yellow to orange-ocherous (sometimes cream-colored), the scales more or less broadly tipped with dark brown, thus producing in darker specimens the appearance of a brownish dusted or irrorated ground color; the pale markings are formed by streaks of the pale ground color, which are however sometimes slightly dusted; three very oblique parallel pale costal streaks extend to the middle of the wing, the first at basal fifth is narrowly separated from the costa by the dusted ground color, the third is the best defined, the scales at its inner margin more deeply brown-tipped; a short oblique streak from dorsum, often ill-defined or its position indicated only by the dark-tipped scales margining it toward base, meets the third costal streak at an acute angle (about 60°); a patch of black raised scales just within the middle of the dorsal margin followed by scattered black-tipped scales, some of which are raised; apical area sometimes less dusted by dark-tipped scales, thus contrasting; just before apex a whitish triangular spot partly in the cilia; a small irregular black apical spot from which a faint line of dark-tipped scales extends along termen, both spot and line sometimes lacking; a second more conspicuous line in the middle of the whitish cilia curves around apex from the whitish triangular spot to tornus. Hind wings and cilia yellowish white to pale silvery gray. Legs pale yellow, the white hind tarsal segments black-tipped. Abdomen whitish, with faint fuscous shading.

Alar expanse 6 to 7.5 mm.

Male genitalia (figs. 204, 204a). Harpes typical of the section, truncate, setose outwardly; socii rounded, incurved and bent ventrad, with long setae; anellus not differentiated as a definitive structure, but the membrane minutely

setose; aedeagus long, stout, abruptly curving to apex, aperture margined laterally by toothed flaps, teeth varying in number; cornuti, a group of three strong teeth; vinculum with anterior lobe. Scale sac absent.

Female genitalia (figs. 205, 205a, 206). Posterior margins of segment 7 fringed with long pointed specialized scales; a sclerotized band across the posterior dorsal margin of ostium, curving around ostium and terminating in two points, sclerotization prolonged posteriorly into a two-lobed process; ostium and ductus bursae in segment 7 strongly sclerotized, margin of ostium and ductus bursae immediately before ostium armed with teeth; signum ribs strongly sclerotized and bearing short appressed teeth, between the ribs lines of fine teeth, anterior to these, groups of microscopic teeth, arranged in more or less transverse rows (fig. 205a).

Type.—♂, with cocoon, Ottawa, Ontario, 5.VII.1955, "*Quercus macrocarpa*" (G. G. Lewis) [C.N.Coll., Type No. 7198].

Allotype.—♀, Ottawa, Ontario, July 23, 1934 (C. H. Young) [C.N.Coll., Type No. 7198].

Paratypes.—1 ♂, 1 ♀, with cocoons, Ottawa, Ontario, 8.VII, 10.VII.1955, "*Quercus macrocarpa*" (G. G. Lewis) [C.N.Coll.]; 1 ♀, Toronto, Ontario, 25.5.15 [Cornell U.]; 1 ♂, Cohasset, Massachusetts, June 8.07 (Owen Bryant Collector) [J. R. Eyer Coll.]; 1 ♀, Waltham, Massachusetts, Sept. 22 (Morgan Hebard) [A.N.S.P.]; 1 ♀, with cocoon on fragment of oak leaf, Kirkwood, Missouri (probably), "*Bucculatrix* on oak," 4/23.85 (284), "From Miss Murtfeldt" [U.S.N.M.]; 1 ♀, no locality, but probably Missouri, "on white oak," 8/2.86, cocoon accompanying (Murtfeldt Coll.) [Cornell U.]; 1 ♂, Essex Co., N. J., V.24 (W. D. Kearfott) [U.S.N.M.]; 1 ♂, with cocoons on fragments of oak leaves, Washington, D. C., "AB114, iss. July 29-9" [U.S.N.M.]; 13 ♂, 18 ♀, Highlands, Macon Co., North Carolina, 3865 feet, August 3 to September 3, 1958, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.]; 3 ♂, 6 ♀, Cherry Hill Recreation Area, Rte. 107, Oconee Co., South Carolina, 2000 feet, August 11 to September 6, 1958, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

The food plant of the Ottawa series is *Quercus macrocarpa* Michx.; where this oak is not native, other species of the white oak group replace it as a food plant. There are no data on the mining stages. The cocoon is pale yellow, with eight or nine ridges; except for the fewer ridges and pale yellow color, it resembles that of *B. packardella* Chambers.

When the ground color of the fore wings is a bright yellow or orange-ocherous, and the pale markings are distinctly yellow, the species can be recognized easily. Specimens in which the clear yellow of

ground color and markings is obscured by dark dusting, if merely slightly abraded in the basal area of the wing, can scarcely be differentiated from *packardella*, except by genitalia.

Genitalia slides of type and allotype, and slides of the Missouri, Washington, D. C., North Carolina, and Cohasset, Massachusetts specimens demonstrate the specific identity of the series. The unusual genitalia separate this widely distributed species from all others.

It is understandable that this species should have been identified as *litigosella* Zeller, as Zeller's description of *litigosella* agrees with the more densely dusted specimens of *recognita*. The genitalia of the two species are quite different. The specimen labeled *litigosella* by Forbes and referred to on page 157 of Memoir 68, Cornell University Agricultural Experiment Station is the specimen from the Murtfeldt Collection reared on white oak (probably from Missouri); it is included among the paratypes of *recognita*.

(82) **Bucculatrix paroptila** new species

(Figs. 209, 210.)

Face pale stramineous, tuft ocherous, with brown hairs centrally; eye-caps stramineous, shading to reddish ocherous outwardly, antennal stalk dark brown, with narrow paler annulations. Thorax ocherous or golden brown, extreme base of fore wing ocherous. Fore wings golden brown, each scale tipped with darker brown, giving the wing a finely speckled appearance; markings brilliant silvery; from basal fifth of costa, an oblique bar to fold, and on dorsal margin opposite its apex and often nearly in contact with it, a brilliant silvery spot, followed immediately by a patch of black raised scales; a second, less oblique and shorter bar from middle of costa; at two-thirds the wing length, a wedge-shaped perpendicular silvery mark, and opposite it on dorsum a somewhat narrower silvery mark, also perpendicular to margin; a black apical spot, margined toward base by silvery scales; from the pale costal cilia just before apex, a line of black-tipped scales extends around apex through the cilia to tornus. Hind wings and cilia dark gray-brown, darker than the fore wings. Legs dull ocherous, more or less shaded with dark fuscous. Abdomen fuscous above, silvery gray beneath.

Alar expanse 6 to 7 mm.

Male genitalia (fig. 209). Harpes typical of the section, long setose, apex evenly rounded, a small basal process; socii tapering and curving toward mid-dorsal line, setose; aedeagus widest beyond middle and thence tapering to acute apex; vinculum a slender thread. Scale sac large, subglobose, scales of two kinds, very small dark scales and long, irregularly pigmented scales.

Female genitalia (fig. 210). Posterior dorsal margin of segment 7 fringed with long specialized scales, posterior ventral margin with a short row of specialized scales each side of mid-ventral line; on intersegmental membrane, an

arc of short broad specialized scales; ostium flared, lateral margins prolonged into acute curved points, ventral margin with two short pointed processes; signum the typical ring of spined ribs, spines long and slender.

Type.—♂, Augusta, Maine, July 4, 1947 (A. E. Brower) [U.S.N.M., Type No. 65034].

Allotype.—♀, Bar Harbor, Maine, July 11, 1937 (A. E. Brower) [U.S.N.M.].

Paratypes.—1 ♂, 1 ♀, Augusta, Maine, June 27, 1942, "on *Comptonia asplenifolia*," [genitalia slides from these paratypes]; 1 ♂, Augusta, Maine, June 30; 3 ♂, 1 ♀, Bar Harbor, Maine, July 2 to July 8; 1 ♀, Bar Harbor, Maine, July 4, "swept from *Myrica gale*" (A. E. Brower) [A. E. Brower Coll.]; 3 ♂, Barnstable, Massachusetts, June 26 to July 6 (C. P. Kimball) [C. P. Kimball Coll.]; 1 ♂, Merivale, Ontario, 22.VI.1933 (G. S. Walley) [C.N.Coll.]; 1 ♀, White Pt. Bch., Queens Co., Nova Scotia, 13.VII.1934 (J. McDunnough) [C.N.Coll.].

In addition to the type series, there are twelve specimens, ♂ and ♀, from the Brower and Kimball collections, not in good enough condition to be included in the type series, but recognizable if associated with specimens in better condition.

There is little doubt that *Comptonia asplenifolia* (*C. peregrina* (L.) Coult.), and *Myrica gale* L. are the food plants of this species; the imagoes of species of *Bucculatrix* commonly rest on leaves of the food plant.

Bucculatrix paroetila may be recognized by the uniform brown speckling of the fore wings, with lustrous silvery marks, of which the pair at two-thirds the wing length are perpendicular to the wing margins, and by the dark hind wings.

(83) ***Bucculatrix fugitans*** Braun (Figs. 18, 55, 55a, 55b, 55c, 211, 211a, 212.) 1930. *Bucculatrix fugitans* Braun, Trans. Amer. Ent. Soc. LVI: 15. Type ♂, Mineral Springs, Adams County, Ohio [A.F.B.Coll.].

Face pale ocherous, tuft fulvous; eye-caps very small, stramineous, shading to fulvous, antennal stalk dark fuscous in male, with narrow pale annulations in the outer half only, fulvous near base in female, shading to dark fuscous and annulate in outer half. Thorax and extreme base of fore wing fulvous. Ground color of the fore wing (fig. 18) dark brown, almost black, with lustrous pale golden marks; a moderately broad, straight or slightly curved pale golden fascia at one-fourth, followed just within the dorsal margin by a large patch of black raised scales; a pale golden oblique spot near middle of costa, and another at three-fourths; an oblique pale golden spot before tornus; a small pale golden transverse mark at apex; marginal line of blackish scales sharply contrasting

with the pale fulvous cilia. Hind wings and cilia fuscous, darker in males. Legs dark fuscous above, hind tarsal segments pale at base, hairs of hind tibiae mingled fuscous and pale fulvous. Abdomen stramineous beneath, dark fuscous above.

Alar expanse 6 to 7 mm.

Male genitalia (figs. 211, 211a). Harpes typical of the section, apex evenly rounded, setose; socii short, broad, setose; aedeagus stout, abruptly tapering near apex to the acute dorsally directed tip; vinculum a slender thread. Scale sac very large, subglobose, in diameter nearly equalling the length of segment 2; scales slender.

Female genitalia (fig. 212). Apophyses short; posterior margins of segment 7 fringed with specialized scales, those on the dorsal margin short, those on the ventral margin long, with the longest scales mid-ventrally; on the intersegmental membrane ventral to ostium, a curved row of short specialized scales; on dorsal anterior margin of segment 8, a short row of very small specialized scales; dorsal margin of ostium sclerotized and produced laterally into sharp points; ductus bursae long, bursa copulatrix extending from segment 5 into segment 2, with the signum in segments 3 and 4; signum a ring transversely placed, signum ribs armed on each side with short sharp spines as in *callistricha* (see fig. 213a).

Specimens examined.—5 ♂, 6 ♀.

OHIO: Mineral Springs, Adams County, ♂ type, 4 ♀ paratypes, rearing record B.1352, from larvae on *Corylus americana* Walt., imagoes July 20 to 23 (paratypes), July 30 (type), 1928; Pond Lick, Scioto County, 2 ♂, 2 ♀, rearing record B.2180 (on *Corylus americana*), imagoes July 16 to July 22, 1953 (A. F. Braun) [A.F.B.Coll.].

MASSACHUSETTS: Framingham, 1 ♂, VI.1.07 (C. A. Frost) [A. E. Brower Coll.].

MAINE: Oxbow, 1 ♂ (in poor condition), VI.6.41 [A. E. Brower Coll.].

In addition to *Corylus americana* Walt., the food plant in the New England localities may be *Corylus cornuta* Marsh. The egg is deposited on the upper side of the leaf, over the midrib or on one of the principal lateral veins. The very fine linear mine (fig. 55a) is much contorted, often bent back on itself. The thin, but dense papery moulting cocoons are spun on the underside at the margin of the leaf. After leaving the first moulting cocoon (i.e. in the fourth instar) the larva eats at first one or two very minute patches of leaf in which the upper epidermis is left intact; in all subsequent feeding, the entire leaf substance is consumed; in the last instar, the holes form elongate patches, divided by fine lines only (fig. 55b). The mature larva is green, shading to reddish toward the head, setae very minute. The cocoon (fig.

55c) is reddish brown, short and stout, with eight ridges, which are sometimes ill-defined.

By the last week of June, most of the larvae have left the mines and are feeding externally. Feeding is completed early in July, with emergence of the imagoes during the latter part of July.

No larvae of a generation overwintering in the pupal state have thus far been discovered; such a generation is indicated by the early June dates of the Massachusetts and Maine specimens. Considerable time may elapse between deposition of eggs and the discovery of feeding larvae on the leaves; such larvae (in Ohio) should probably be looked for in October. Thus far, any larvae collected in late July, in August, and in early September have proved to be the following species, *B. callistricha* new species.

(84) ***Bucculatrix callistricha*** new species

(Figs. 17, 33, 37, 213, 213a, 214, 214a.)

Face silvery white, tuft reddish brown, on vertex centrally dark brown; eye-caps silvery white, antennal stalk dark fuscous, apical 8 or 10 segments silvery white. Thorax dark brown, tegulae silvery white. Fore wings (fig. 17) dark brown, almost black, with brilliant silvery marks; a short silvery dash in fold at base; base of dorsal margin narrowly silvery; from basal fourth of costa an oblique silvery streak to middle of wing; a little posterior to the costal streak, an oblique silvery streak from dorsum to fold, followed by a patch of black raised scales, the two streaks not meeting; an oblique silvery streak from middle of costa, and another more slender streak from three-fourths of costa; on dorsum before tornus a triangular silvery spot, anterior to the third costal streak; a transverse silvery mark immediately before apex, and following it at the extreme apex, a small group of black scales which project slightly into the cilia beyond the line of black-tipped scales which extend from costa around apex to tornus; cilia fulvous, becoming fuscous toward tornus. Hind wings and cilia dark fuscous, with slight reddish tinge. Fore and middle legs dark fuscous, hind legs silvery outwardly, tibiae with fuscous hairs, tips of tarsal segments pale. Under-side of abdomen silvery gray, fuscous above in male, paler in female with anal tuft pale ocherous.

Alar expanse 7 mm.

Male genitalia (figs. 214, 214a). Harpes typical of the section, setose on outer surface, with apical margin indistinctly angled by a slight projection, basal process present; socii slightly incurved, setose, tegumen projecting in a small median lobe; aedeagus short, stout, abruptly pointed, its tip directed dorsad; vinculum a very narrow band. Scale sac (fig. 214a) small (compare with that of *fugitans*, fig. 211a, drawn to the same scale).

Female genitalia (figs. 213, 213a). Apophyses long; posterior margins of segment 7 fringed with long specialized scales; on intersegmental membrane ventral to ostium, an arc of closely placed short specialized scales; on dorsal anterior margin of segment 8, a very short row of small specialized scales; dorsal margin of ostium sclerotized and produced laterally into long acuminate points; ductus bursae very short, entering bursa copulatrix near anterior margin of segment 7; bursa extending to anterior margin of segment 3; signum in segment 6, ribs with paired short spines, longer and more strongly sclerotized toward anterior end.

Type.—♂, Beaver Pond, Adams County, Ohio, rearing record B.2193 (on leaves of *Corylus americana* Walt.), imago April 30, 1954 (A. F. Braun) [A.F.B. Coll.].

Allotype.—♀, same data as the type.

Paratypes.—3♂, 5♀, same data as the type, except dates of emergence April 25 to May 3; 1♀, Pond Lick, Scioto County, Ohio, rearing record B.2145, imago May 8, 1951 [A.F.B.Coll.]; 6♂, 3♀, east of London, Laurel County, Kentucky, rearing record B.1486, imagoes May 8 to May 19, 1935 [A.F.B.Coll.]; 2♂, 7♀, Rocky Arbor Roadside Park, Juneau County, Wisconsin, rearing record B.2173 (on leaves of *Corylus cornuta* Marsh.), imagoes April 3 to May 12, 1953 (A. F. Braun) [A.F.B.Coll.]; 1♂, Lac Saguay, Quebec, 9.VI.1941 (G. S. Walley) [C.N.Coll.]; 1♀, Dechenes, Quebec, 23.VI.1933 (G. S. Walley) [C.N. Coll.].

The type series, except the two flown specimens from Quebec, was reared on leaves of *Corylus americana* Walt. and *C. cornuta* Marsh. The egg (fig. 37) is placed on the upper side of the leaf over a vein as in *B. fugitans*; it is broadly oval in outline, tapering but very slightly to the micropylar end and is marked with minute hexagonal reticulations. The very slender thread-like mines, similar to those of *B. fugitans*, but longer, are not distinguishable in the field from those of *B. fugitans* except by the dates when they are occupied by mining larvae. Feeding habits are identical with those of *B. fugitans*; the mature larva, though similarly colored, is more hairy. Cocoon similar to that of *B. fugitans*.

The larvae are actively feeding in the mines in the latter part of July; at this time the leaf immediately adjacent to the early part of the mine is blackened, suggesting that there has been a considerable time interval between feeding in the early and late parts of the mine, and that feeding has recently been resumed. The feeding period is spread over a month or six weeks, as observed for the Ohio specimens; the

earliest date of cocoon spinning was August 4; feeding larvae have been collected as late as September 6. The larvae of the Wisconsin series were collected September 4; September 7 the date of the first cocoon. The imagoes emerge in late April and early May of the following year. The species is apparently single-brooded.

Bucculatrix callistricha is separated from the allied *B. fugitans* by the silvery white tegulae and silvery marks at base of fore wing, the pair of oblique silvery streaks at basal fourth, in contrast to the transverse complete fascia of *fugitans*. Genitalia of the two species differ only in minor details.

(85) ***Bucculatrix eugrapha*** new species

(Figs. 177, 215.)

Face pale stramineous, tuft brown with pale stramineous hairs laterally; eye-caps pale stramineous, antennal stalk gray above, paler beneath. Fore wing brown, with lusterless whitish marks; base of wing especially below the fold, white with faint ochereous tinge; at one-fourth of costa an oblique whitish streak, and opposite its apex just before middle of dorsum, a whitish spot reaching fold is margined behind by a few black raised scales; just before middle of costa, a second oblique pale costal streak; at three-fourths of costa, a nearly perpendicular whitish streak; just before tornus on dorsal margin a slightly oblique whitish streak; at extreme apex a minute black spot, and opposite apex and projecting into the cilia, a short line of black-tipped ochereous scales; scales on costa before apex and along termen project irregularly into the cilia; cilia pale brownish fuscous. Hind wings and cilia fuscous. Legs gray, tarsal segments paler at bases.

Alar expanse 8 mm.

Male genitalia (fig. 215). Harpes typical of the section, median setae long, grading to short and more closely placed setae around apical margin, basal process present; socii broad, setae short; anellus with strongly sclerotized lateral arms; aedeagus tapering to the acute dorsally directed tip, before its apex a thin membranous bilobed ventral flap; vinculum weakly sclerotized, its anterior margin retuse, lateral angles with strongly sclerotized points; posterior margin of segment 8 fringed with long hair-like scales, the intersegmental membrane between it and the genitalia strongly sclerotized. Scale sac (fig. 177) with long slender scales.

Type.—♂, Tweed, Ontario, 7.VII.44 (G. S. Walley) [C.N. Coll., Type No. 7179].

Only the male type is known.

Food plant and early stages unknown.

Bucculatrix eugrapha is easily separated by markings from all other species of the section. In genitalia, distinguishing characteristics are present in the aedeagus and vinculum.

(86) ***Bucculatrix cerina*** new species

(Figs. 216, 216a, 216b.)

Face stramineous, tuft stramineous, on vertex with mingled ochereous and brown hairs; eye-caps and antennal stalk stramineous, the stalk with pale brown annulations. Thorax stramineous, shaded with ochereous. Fore wings pale stramineous, with a decided yellowish cast and lightly dusted with ochereous-tipped scales; markings formed by ochereous oblique transverse bands, in which some of the scales are brown-tipped; the first of these lies almost at base, the second arises before the middle of costa and bears on its inner margin on the fold a small patch of brown raised scales, the third passes across the wing from three-fifths of costa to tornus; separating the third ochereous oblique band from the ochereous apical area is an oblique band of ground color from costa to termen, extreme apex pale; cilia stramineous, with irregularly projecting ochereous scales but without defined ciliary line. Hind wings and cilia pale stramineous. Legs and underside of body pale stramineous, abdomen above faintly fuscous shaded.

Alar expanse 5.5 mm.

Male genitalia (figs. 216, 216a, 216b). Harpes in general typical of the section, but modified in shape, basally broad with heavy setae, contracting at middle, thence slender and parallel-sided, with shorter fine setae; socii small, narrowly oval, sparingly setose, their tips convergent; anellus broad, inverted bowl-shaped; aedeagus typical of the section, tapering to the acute apex; vinculum broad, evenly rounded. Scale sac (fig. 216b) very elongate, scales very long and slender.

Type.—♂, Siesta Key, Sarasota County, Florida, January 5, 1951 (C. P. Kimball) [A.N.S.P., Type No. 7816].

Paratype.—♂, Key Vaca, Monroe County, Florida, XI.13.1952 (C. P. Kimball) [A.N.S.P.].

Food plant and early stages unknown.

Although neither type nor paratype is in perfect condition, the yellow aspect of this species is characteristic. In genitalia, *B. cerina* is distinct from all other described species.

(87) ***Bucculatrix copeuta*** Meyrick

(Figs. 8, 217, 218.)

1919. *Bucculatrix copeuta* Meyrick, Exot. Microlep. II: 288. Types, ♂, ♀, Toronto, Ontario [B.M.].

Head shining white, tuft rarely with a few ochereous-tipped scales; eye-caps large, lustrous white, antennal stalk whitish, faintly marked above with pale gray

dots. Thorax white. Fore wings lustrous white, with pale ochereous, lightly dusted costal and dorsal streaks (fig. 8); the first very oblique costal streak from before middle of costa extends to the middle of the wing; the second from middle of costa extends obliquely to beyond the middle of the wing; from middle of dorsum a less distinct oblique streak (sometimes absent) curves posteriorly and as an attenuated line follows the fold, sometimes meeting the apex of the second costal streak; a broader band crosses the wing irregularly from apical fourth to termen, and is continued along costa and termen by fainter dusting, thus enclosing a pure white area, within which lies the black apical dot; opposite the apical dot, a short line of black scales at base of cilia, not always separated from the apical dot, and a second short line in the cilia, thus forming a series of three black marks at apex. Hind wings pale silvery gray, cilia white. Legs and underside of body silvery white.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 217, 217a). Harpe with an inner lobe, acute near its apex and margined with curved setae; socii prolonged into pointed tips, bearing minute setae on their inner margins near tip, elsewhere long setose; anellus broad, lateral margins narrowly sclerotized; aedeagus stout, aperture appearing hooded, apex curving dorsad to the pointed tip; cornuti, two weakly sclerotized teeth; vinculum narrow, mid-ventrally shortly produced. Scale sac large, globose, outer scales broad, inner linear.

Female genitalia (figs. 218, 218a). On the intersegmental membrane, ventral to ostium, a broad arch of specialized scales, the inner rows of scales near its free ends minute, outer long, grading to a single row of short scales mid-ventrally; ostium abruptly wide; dorsad of ostium a sclerotized plate prolonged posteriorly; ductus bursae sclerotized nearly to segment 6; signum faint, the ring open dorsally, each rib usually with one large strongly sclerotized section, followed by sections terminating in one to several short sharp spines (fig. 218a).

Specimens examined.—3 ♂, 3 ♀.

ONTARIO: Sparrow Lake, 2 ♂, 2 ♀, July 12 to July 17, 1926 (A. F. Braun) [A.F.B.Coll.]; Waubamie, Parry Sound, 1 ♀, June 25 (H. S. Parish) [Cornell U.].

MAINE: Augusta, 1 ♂, "bred ex plum, emgd May 29, 1945" (A. E. Brower) [A. E. Brower Coll.].

Brower records it from "plum", but with no data on the early stages or cocoon. Pin-cherry, (*Prunus pensylvanica* L.f.), is abundant in the area at Sparrow Lake, Ontario, where the four specimens recorded above were collected and may possibly be its food plant there.

In the original description, Meyrick makes no mention of a dorsal streak. In a letter dated November 12, 1927, in reply to mine noting the presence of a dorsal streak in specimens from Sparrow Lake, On-

tario, Meyrick wrote "The two original examples of *Bucculatrix copeuta*, though in very good condition, do *not* show any dorsal streak or trace of it; but since then I have received seven more examples from Canada, which I consider certainly the same species, and some of these show the dorsal streak, one having it quite well-marked as you describe it; no doubt your specimens are the same species, which has a distinct aspect, owing to the pure white ground colour."

The white ground color and ocherous streaks may suggest relationship with the gall-forming species, but the genitalia indicate relationship with the oak and birch feeders. The three black marks placed in sequence at the apex of the wing, although not always sharply separated, are the best identifying characters of *copeuta*.

(88) ***Bucculatrix locuples*** Meyrick (Figs. 57, 219, 220, 220a.)

1919. *Bucculatrix locuples* Meyrick, Exot. Microlep. II: 287. Type ♂, Toronto, Ontario [B.M.].

1923. *Bucculatrix locuples* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 159.

Face lustrous pale ocherous, tuft dark reddish brown, rarely paler; eye-caps pale ocherous, antennal stalk dark fuscous, with broad whitish annulations in the outer half. Thorax reddish black. Fore wings black, with faint bronzy tinge, marks lustrous pale golden; before middle of costa, a triangular oblique golden spot; at two-thirds of costa, a slightly less oblique golden spot; before middle of dorsum and anterior to the first costal spot, a triangular golden spot reaching to fold or beyond and bordered outwardly by a large patch of black raised scales; at tornus a second triangular golden spot; cilia gray, with a line of black-tipped narrow scales extending from costa before apex to tornus. Hind wings irrorated dark fuscous, cilia concolorous. Posterior tibiae, except the hairs, yellowish silvery; first tarsal segment blackish, remaining segments silvery, with darker tips. Abdomen dark bronzy fuscous above, paler beneath.

Alar expanse 6 to 7 mm.

Male genitalia (fig. 219). Male genitalia in general agreeing structurally with the section characters, but differing in appearance and with some notable specializations; harpes elongate, narrow, tapering to the acute concave curved apices, median setae long, apical short, the basal process strong, curved, sclerotized, more or less fused with vinculum; the costal free arms of harpes stout and sinuate; socii oval, concave, setose; anellus cylindric; aedeagus long, tapering to a sharp point, aperture elongate, nearly half the length of the aedeagus, with a long slender spine arising from its anterior angle; vinculum sclerotized, produced anteriorly into an acute angle. Scale sac absent.

Female genitalia (figs. 220, 220a). Dorsal and ventral margins of segment 7 fringed with very long slender dark-pigmented scales; on the intersegmental membrane ventral to ostium, a narrow transverse sclerotized irregular line; margins of ostium sclerotized and produced posteriorly; from membrane within ventral margin of ostium, a free pouch-like invagination; signum the usual ring, very narrow dorsally, the ribs strongly sclerotized, spines acute (fig. 220a).

Specimens examined.—5 ♂, 13 ♀.

KENTUCKY: Plummer's Landing, Fleming County, 2 ♀, rearing record B.1692 (on *Alnus serrulata* (Ait.) Willd.), imagoes April 16, April 30, 1941; Crain Creek, Fleming County, 3 ♂, 3 ♀, rearing record B.2225 (on *Alnus serrulata*), imagoes April 25 to May 7, 1956; Morehead, Rowan County, 1 ♂, 7 ♀, rearing record B.2226 (on *Alnus serrulata*), imagoes May 2 to May 12, 1956 (A. F. Braun) [A.F.B.Coll.].

QUEBEC: Fairy Lake, 1 ♂, 1 ♀ (*Alnus* sp., record number 55-194) 25, 30.VI.1956 (T. N. Freeman) [C.N.Coll.].

In addition to the localities listed above, larval work of this species has been observed on *Alnus serrulata* in Montgomery County, Kentucky, and in Jackson and Vinton counties, Ohio.

There are two generations a year (in Ohio and Kentucky); larvae of the first generation pupate early in July, the imagoes emerging the same season; larvae of the second generation, much more numerous, may be collected during September, pupating from mid-September to early October, such larvae producing imagoes the following spring. The mine (on *Alnus serrulata*) is a slender thread, about 2.5 cm. in length, its early part filled with black frass and thus difficult to detect on the leaf. The moulting cocoons, on the underside of the leaf, are papery in texture and orange ochreous in color. In the last two instars, as an external feeder, the larva eats irregular patches of leaf tissue, leaving the upper epidermis intact. Previous to spinning the cocoon, the larva outlines the area selected with erect strong curled silk threads. The hairy cocoons (fig. 57), spun on twigs, vary in color from bright brown to almost black, most commonly the latter; eight prominent longitudinal ridges, with sometimes an additional indistinct ridge on either side; the ridges of the anterior section are raised at the junction with the posterior section, the ends of the ridges projecting at right angles to the longitudinal axis of the cocoon.

In genitalia of both sexes *locuples* is scarcely distinguishable from the European *cidarella* Zeller, also an alder feeder. Although the

marks of the fore wings of *locuples* are the same in number as in *cidarella* and similarly placed, their brilliant golden luster separates *locuples* from *cidarella*.

(89) ***Bucculatrix ainsliella*** Murtfeldt (Figs. 19, 19a, 221, 222, 222a, 222b.)

1905. *Bucculatrix ainsliella* Murtfeldt, Canad. Ent. XXXVII: 218. Type ♂, with genitalia slide by Busck, Olmstead County, Minnesota [U.S.N.M., Type No. 65035]; allotype ♀, with genitalia slide by Busck, Olmstead County, Minnesota [U.S.N.M.]; both pinned on the same mount, and here designated type and allotype.

1923. *Bucculatrix ainsliella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 159.

Face creamy white, tuft white laterally, dark brown centrally; eye-caps whitish, dotted with brown and dark brown on posterior margins, antennal stalk whitish with dark brown annulations and with intervening white segments producing a characteristic marking as follows: basal half of stalk regularly annulate, then follow one white, two dark brown, one white, four dark brown, one white segment, followed by regularly annulate segments, last few segments pale. Thorax whitish, densely dusted with dark brown-tipped scales which form several defined dark marks. Whitish ground color of the fore wing more or less obscured by the dense dusting of dark brown-tipped scales, of which the more broadly dark-tipped scales form the dark markings. The species varies greatly in density of dusting and definition of markings, and thus the markings described may not always be discernible. A dark shade along costa broadens outwardly to beyond middle of costa, narrowing below costa and as an oblique streak passing across the wing to termen there meeting a small patch of black scales; in the middle of the wing, a short streak of whitish scales lies along the outer border of this dark oblique streak; the dark shade along costa may be indistinctly interrupted near base and before middle by slightly paler oblique shades; on the middle of the dorsal margin a half-oval conspicuous brown spot, straight on the dorsal margin, and bearing within its inner edge a patch of black raised scales, and bordered before and behind and narrowly above by whitish scales; apical area of wing less densely dusted, but with an aggregation of dark scales at extreme apex; cilia with a median line of dark-tipped scales. Hind wings pale silvery gray, cilia tinged with fuscous. Legs and underside of body shining gray.

Alar expanse 7 to 8 mm.

Male genitalia (figs. 222, 222a, 222b). Harpe setose, with curved process at apex, the concave base appressed to the bulbous base of aedeagus; a narrow sinuate band may represent transtilla; socii elongate, setose, with a row of a few stronger setae inwardly; anellus absent; aedeagus narrow cylindric, enlarging to a strongly sclerotized bulbous base, with conspicuous cornuti, consisting of two parallel rows of strong curved setae; anterior to the bulbous base, a more

membranous narrow segment curving to the left and posteriorly; vinculum and tegumen weakly sclerotized. Scale sac and the scales very elongate.

Female genitalia (fig. 221). On anterior dorsal margin of segment 8, a mass of small dark scales, inserted on a broad triangular area (only a few of the scales shown on the figure); ostium oval, ductus bursae wide and strongly sclerotized near ostium, abruptly narrowing anterior to the sclerotized section, with inception of ductus seminalis just anterior to the sclerotized section; ductus bursae very long, several times the length of the body, coiled, and, except in its posterior third, armed with rows of teeth; signum a ring, made up of separated groups of spined ribs.

Nearly 100 specimens representing both sexes have been examined, including type material in the United States National Museum. Some twenty-five specimens from Rochester, New York, in the National Museum (Kearfott Collection) are erroneously labeled "Topotype." In the various collections, specimens have been examined from North Carolina (Highlands, 3865 feet) and South Carolina (Cherry Hill Recreation Area, 2000 feet, Oconee County), collected by R. W. Hodges as part of a project sponsored by the American Philosophical Society; from New Jersey (Essex County Park and Watchung Mts.), Pennsylvania (Pittsburgh, one specimen only), New York (Rochester, Long Island, Monroe County), Connecticut (East River, New Haven), Massachusetts (Barnstable, Beverley, Martha's Vineyard), Maine (Augusta, Bar Harbor), Nova Scotia (Annapolis, "bred from red oak"), Ontario (St. Catherines, "host, *Quercus borealis*"), Michigan (Wayne County), Minnesota (Olmstead, the type material). Some of these specimens are accompanied by cocoons, some bear notations "cocoon on oak", "on oak," on "*Quercus rubra*," "on chestnut," "bred, skeletonizer *Quercus borealis*."

This widely distributed common species was originally described from Minnesota specimens. Its distribution appears to follow a definite pattern. It is reported to be present in great numbers on the oaks along the Blue Ridge Parkway and has been collected in North Carolina and in adjacent South Carolina. From there it occurs northward along the Appalachian Highlands and the coastal area of New England to Nova Scotia and west across the North to Minnesota. There are no records from the more southern midwestern states.

Bucculatrix ainsliella is sometimes common enough to be of economic importance. From Miss Murtfeldt's account I quote the follow-

ing: "Some of the leaves received from my correspondent [C. N. Ainslie] had attached—generally to the under surfaces—crowded groups of from twenty to thirty cocoons, and on many of the grass blades were double rows from one and one-half to two inches in length."

Various species of oak and also chestnut are attacked by the larvae. Black oak (*Quercus velutina* Lam.) appears to be the preferred food in the type locality (Minnesota), red oak (*Quercus rubra* L.) in other localities. The short thread-like mine (observed on red oak near St. Cloud, Minnesota) follows the midrib or a principal vein for most of its length, then sharply diverges from the vein; the exposed larva feeds on the underside of the leaf, skeletonizing it. The white cocoon, tapering to each end, has six rather low and sometimes indistinct ridges. The winter is passed in the pupal state, with emergence the following spring. The specimens examined bear dates from April to early August and to early September in North Carolina. These later dates suggest either a long period of emergence, or in favorable localities, a possible summer generation with feeding larvae in late June or early July.

The Nova Scotia series is paler and less densely dusted, with the dark marks more sharply contrasting. The peculiar antennal markings are present also in *B. pomifoliella*, the wing markings of which are similar. Genitalia of both sexes serve to separate *B. ainsliella* from all other species of our fauna. Although the genitalia display much modification from the general type of the section, the harpe of the male indicates its assignment to this section.

(90) ***Bucculatrix eelecta*** new species

(Figs. 223, 224, 224a.)

Face creamy white, tuft brown centrally with pale stramineous hairs laterally; eye-caps creamy white, rough-scaled, and dotted with brown-tipped scales; antennal stalk with alternating white and fuscous rings of equal width. Thorax creamy white, dotted with brown-tipped scales. Fore wings creamy white and dusted with ochreous brown-tipped scales; aggregations of ochreous more broadly brown- or fuscous-tipped scales form the markings; extreme base of wing white and nearly immaculate; beyond this a broad ochreous band angled on the fold crosses from costa to dorsum, where there are a few raised scales; from before middle of costa, an oblique ochreous band, angled on the fold may (in ♂ type) extend as a broad band to dorsum, including within its inner border a patch of blackish raised scales; this band is bordered inwardly by an oblique pale costal

streak, which may join, on the disc, a second pale costal streak, the two then dividing to encircle a brown oval spot below fold, which includes the above-mentioned patch of blackish raised scales; just beyond middle of costa, an oblique dark streak, the most conspicuous mark on the wing, is marked at the end of cell by a minute black dot, and as a more diffuse band attains tornus and termen; this band is separated from the ochereous more or less triangular costal area before apex by a narrow pale oblique costal streak; extreme apex stramineous, opposite apex a few blackish scales project into the cilia and minutely dark-tipped scales form a line in the pale stramineous cilia from costa before apex to tornus. Hind wings and cilia pale stramineous, with a faint reddish fuscous tinge toward apex. Legs pale stramineous, with little fuscous shading. Abdomen stramineous, fuscous above, darker in male.

Alar expanse 6.5 to 7 mm.

Male genitalia (figs. 224, 224a). Harpes fused with vinculum, a broad concave thin ventral lobe, clothed distad with long outwardly oblique setae, its inner margins convex and approximate on mid-ventral line; apical fourth of harpe (cucullus) distad of this lobe is more strongly sclerotized and is clothed with regularly spaced strong short setae; a basal process articulating on tegumen, free arms of costa slender; socii small, much exceeded by the harpes, finely setose; anellus an asymmetric ring; aedeagus (fig. 224a) cylindric in basal half, apical half with an angular projection beyond which it gradually narrows in an arc to the apex; vinculum a nearly equilateral triangle. Scale sac present; the long slender scales with granular pigmentation.

Female genitalia (fig. 223). Segment 9 elongate, ovipositor projecting in the dried specimen; dorsal posterior margin of segment 7 fringed with short specialized scales, ventrolateral posterior margins fringed with long scales, sternite with strongly sclerotized sinuate transverse wrinkles; ostium circular, small, opening into a parallel-sided depression, which is subtended posteriorly by a small sclerotized arc; ductus bursae narrow near ostium, widening beyond anterior margin of segment 8; spines of signum ribs acicular.

Type.—♂, Simcoe, Ontario, on *Ulmus pumila*, record number 56-176, August 7, 1956 (G. G. Lewis) [C.N.Coll., Type No. 7180].

Allotype.—♀, New York (? Albany), "on elm, Dr. Felt, iss. July 31, 1919," with cocoon [U.S.N.M.].

Paratypes.—3 ♂, 4 ♀, same data as the type, with dates of emergence from August 6 to 16 (G. G. Lewis) [C.N.Coll.]; 1 ♀, "on elm, iss. July 21, 1919" with cocoon (E. P. Felt) [U.S.N.M.]; 6 ♂, 1 ♀, Augusta, Maine, June 5 to 18, July 26, August 7, August 27 (A. E. Brower) [A. E. Brower and A.F.B. Coll.].

The food plant of the Ontario series (*Ulmus pumila* L.) is not native to this continent; it is however commonly planted, and the species has evidently transferred to it from one of our native species of

elm. Cocoons, accompanying the reared Ontario series and the two New York specimens "on elm", are black or blackish brown, rather short, with a varying number of longitudinal ridges, which appear as paler lines.

In all characters, the imago of this species displays its near relationship to the European *B. ulmella* Zeller. The aspect of the imago is that of a diminutive *ulmella*; the configuration of markings is identical. Genitalia of both sexes confirm this relationship; the female genitalia are closely similar, but in the male, the more elongate harpes, the very different aedeagus, and the presence of a scale sac sufficiently differentiate this species from *ulmella*. The cocoons are not at all alike; in a cocoon accompanying a specimen of *B. ulmella* in the United States National Museum, the ridges diverge diagonally from mid-dorsum; the color is a pale brownish yellow.

The male genitalia of *Bucculatrix eclecta* are transitional between the type exemplified by the preceding twenty-five species and the specialized type common to the Malvaceous feeders.

SECTION V

Species 91 to 93

Included in this section are three species feeding in the larval state on members of the genus *Ceanothus*. The section is characterized by the unique male genitalia (figs. 225, 227). In the female, the radiating ribs of the broad signum and the sclerotized posterior projections of the genital segments are diagnostic characters.

(91) ***Bucculatrix anaticula*** new species (Figs. 225, 225a, 226.)

Face white, with fine fuscous dots, tuft white with grayish hairs intermixed; eye-caps white dotted with fuscous, antennal stalk white with grayish annulations, the white interspaces narrower toward apex. Thorax white, dotted with fuscous. Fore wings chalky white, the ground color more or less obscured by the dusting of fuscous-tipped scales; the markings are formed by aggregations of dull clay-colored scales, which are more or less broadly tipped with fuscous, and by lines or small groups of black or black-tipped scales; from basal third of costa, a narrow oblique streak may curve slightly outward in the middle of the wing or may become obsolete below costa; from middle of costa, a broad oblique band crosses the wing; opposite its end in the cilia, a few black scales; from the middle of the outer margin of this band, a short longitudinal spot composed

of a few black scales is margined toward costa with white scales; between the band and apex of the wing, a patch of clay-colored scales which may join the band and thus surround the black spot and the white scales above it; a streak of dark-tipped scales along the basal third of fold; an ill-defined clay-colored patch of fuscous-tipped scales on middle of dorsum bears on its inner margin a small group of black raised scales; cilia white, the costal cilia speckled with fuscous-tipped scales, which tend to form a line curving around apex at the base of the cilia; a second sharply defined line of dark-tipped scales through the middle of the cilia from apex to tornus. Hind wings shining pearly white, or faintly grayish ochereous tinged in male. Legs whitish, tarsal segments black-tipped. Abdomen whitish beneath, fuscous shaded above.

Alar expanse 7 to 7.5 mm.

Male genitalia (figs. 225, 225a). Harpes geniculate near apex, the dark brown or blackish pointed tips strongly sclerotized and meeting in the median line, the aspect of this section of the harpe suggesting a duck's bill; a median elongate pointed dorsal process with lateral basal protuberances probably represents the gnathos; socii flattened, incurved, setose; anellus with a sclerotized supporting rod produced anteriorly to a bulbous base; the long slender aedeagus surrounded by a bulbous base (fig. 225a) from which it is emitted, two sclerotized rods within the bulbous base lateral to the base of the slender tube of the aedeagus; vinculum broadly rounded. Scale sac large.

Female genitalia (fig. 226). Sclerotized sharp lateral projections at the posterior margins of the strongly sclerotized segments 7 and 8; anterior apophyses present as slender rods from the lateral anterior margins of segment 8; the wide ostium in the intersegmental membrane at anterior margin of segment 8; the signum occupies a large area on the ventral surface of the bursa copulatrix in segments 3 and 4, where the signum ribs converge toward the median ventral area, from its posterior end at the entrance of the ductus bursae a narrow ring encircles the ductus dorsally.

Type.—♂, Constance Bay, Ontario (near Ottawa), on *Ceanothus americanus*, June 7, 1956 (G. G. Lewis) [C.N.Coll., Type No. 7181].

Allotype.—♀, Constance Bay, Ontario, "reared on *Ceanothus*," 28-1-1933 (G. S. Walley) [C.N.Coll., Type No. 7181].

Paratypes.—4 ♂, 6 ♀, same data as the allotype, except dates of emergence 25-1-1933 to 31-1-1933; 1 ♀, same data as the type, except emergence June 11 [3 ♂, 5 ♀, C.N.Coll., 1 ♂, 1 ♀, A.F.B.Coll.].

The food plant, *Ceanothus americanus* L., is widely distributed, and with further collecting *B. anaticula* will be found to have a much wider range than is indicated by the type series. Mines, probably made by this species, have been observed on leaves of *Ceanothus americanus* on Clack Mountain, Rowan County, Kentucky in early July and late August, but no imagoes have been reared. Here the egg is deposited on

the upper side of the leaf; all parenchyma is consumed toward the end of the very fine linear mine. Cocoons (accompanying the type series) are white, with six distinct ridges, and often an additional ill-defined ridge on each side. Under natural conditions imagoes emerge early in the summer.

This species and the two following form a closely related group of species, similar in markings and in the characteristic male genitalia, different from anything else in the genus, and are only separated from one another by slight differences.

(92) ***Bucculatrix disjuncta*** new species (Figs. 227, 227a.)

Face white, with minute and scattered pale ocherous dusting, tuft white, with a few pale ocherous hairs; eye-caps white, ocherous dusted, antennal stalk white with pale ocherous gray annulations. Thorax white with pale ocherous dusting. Fore wings white, indistinctly and sparsely dusted with pale ocherous-tipped scales; the markings formed by groups of ocherous and black-tipped ocherous scales; just within the costal margin from base to one-third, a fine line of dark-tipped scales; from basal third of costa, a narrow oblique streak not reaching the middle of the wing; from middle of costa, a broad oblique triangular streak of dark-tipped scales, its apex joining in the middle of the wing an ill-defined patch of pale ocherous scales which continues across the wing to termen there meeting a few black scales; at the apex of this streak in the middle of the wing a few black scales placed longitudinally, with a patch of white scales above them; between this oblique streak and apex of the wing, a small patch of ocherous scales; basal third of fold faintly ocherous; just below middle of fold a group of black raised scales, followed by a patch of ocherous scales, only a few of which are dark-tipped; a few dark scales at extreme apex of wing; cilia white, the costal cilia minutely speckled, a ciliary line of dark-tipped scales from apex toward tornus. Hind wings silvery, faintly ocherous tinged. Tarsal segments broadly blackish fuscous-tipped.

Alar expanse 7.5 mm.

Male genitalia (figs. 227, 227a). Harpes slender, geniculate near apex, the apical section less abruptly pointed than in *anaticula*, its dark brown tips strongly sclerotized and meeting in the median line; a median elongate pointed dorsal process with rounded basal protuberances probably represents the gnathos; socii large, broadly flattened; anellus with sclerotized supporting rod produced anteriorly to an elongate bulbous base; the slender thread-like aedeagus surrounded by a bulbous base similar to that of *anaticula* but differing in proportions; vinculum broadly rounded. Scale sac large.

Type.—♂, Denver, Colorado, on *Ceanothus*, iss. July 14, 1901 (H. G. Dyar) [U.S.N.M., Type No. 65036].

The elongate cocoon, accompanying the type specimen, is white, with indistinct low ridges.

This species is closely related to the preceding species and to *B. ceanothiella* Braun and in fact was identified in the United States National Museum as the latter. While closely related to both of these species, the aspect of the moth is different from either; a comparison of the male genitalia with the genitalia of *anaticula* shows well defined differences, chiefly in the shape of the harpes and the bulbous base of aedeagus, and in the shape and size of the socii.

(93) **Bucculatrix ceanothiella** Braun

(Fig. 230.)

1918. *Bucculatrix ceanothiella* Braun, Ent. News XXIX: 246. Type ♀, Colton, San Bernardino County, California [A.F.B.Coll.].

Face white with minute sparse brown dusting; tuft white with a few brown hairs; antennae white, the eye-caps dusted, especially posteriorly, with brown-tipped scales, the stalk conspicuously annulate with brown. Thorax white, tegulae tipped with brown scales. Fore wings white, dusted with minutely brown-tipped scales; the markings are formed by lines and aggregations of more broadly brown- and black-tipped scales; such a line of dark scales lies just within the costal margin from base nearly to one-third the wing length; at one-third a triangular costal streak less oblique than the corresponding streak in the two preceding species; just beyond the middle of costa, a large patch of dark-tipped scales becomes attenuated in the middle of the wing and continues as a line of dark-tipped scales to middle of termen; a group of dark-tipped scales in apex of wing; an ill-defined line of dark-tipped scales from base on the fold; a large semicircular spot on middle of dorsum, with a few blackish raised scales on its inner margin; cilia white, costal cilia dusted with minutely dark-tipped scales, which form a well-defined ciliary line from apex to tornus. Hind wings and cilia pale silvery gray. Legs whitish, tarsal segments dark-tipped, middle tibiae with fuscous bars. Abdomen whitish.

Alar expanse 6.5 mm.

Female genitalia (fig. 230). Segment 8 strongly sclerotized, its lateral posterior margins projecting; posterior margin of segment 7 with rounded marginal sclerotized depressions in the intersegmental membrane; anterior apophyses present; ostium small, in intersegmental membrane at the anterior margin of segment 8; ductus bursae with a short membranous section followed by a strongly sclerotized section from the middle of segment 7 to the middle of segment 6, where the ductus seminalis enters; signum ventrally broadly expanded laterally and anteriorly, the ribs diverging obliquely and anteriorly from the mid-ventral line, narrowing to encircle the bursa copulatrix dorsally near its posterior end.

Known only from the female type, reared on *Ceanothus* sp., Colton, San Bernardino County, California. The mined leaf was collected in February, emergence of the imago April 10.

The mine is a small irregular brownish blotch, with merely a very short early portion linear; on leaving the mine the larva feeds on the lower surface of the leaf leaving the upper epidermis intact. The white cocoon is shorter and stouter than that of either of the two preceding species, with only four low ridges and a faint indication of a fifth.

The wing markings in *B. ceanothiella* are slightly less oblique than in *B. anaticula* and in *B. disjuncta*; the abrupt narrowing of the costal streaks gives them a more or less quadrate aspect. In female genitalia it is distinct from *anaticula*.

SECTION VI

Species 94

But a single species of our fauna, *Bucculatrix pomifoliella* Clemens is included in this section; the European *B. crataegi* Zeller belongs here also. The male genitalia are distinctive.

(94) *Bucculatrix pomifoliella* Clemens

(Figs. 228, 228a, 228b, 228c, 229, 229a.)

1860. *Bucculatrix pomifoliella* Clemens, Proc. Acad. Nat. Sci. Phila.: 211.

Type ♀, Easton, Pennsylvania [A.N.S.P., Type No. 7501].

1872. *Bucculatrix pomifoliella* Stainton, Tineina of No. Amer., p. 146.

1872. *Bucculatrix pomifoliella* Riley, Rep. Ins. Mo. IV: 149.

1873. *Bucculatrix pomifoliella* Chambers, Canad. Ent. V: 150.

1875. *Bucculatrix pomifoliella* Zeller, Verh. zool.-bot. Ges. Wien XXV: 353.

1880. *Bucculatrix pomifoliella* Walsingham, Trans. Amer. Ent. Soc. X: 204.

1903. *Bucculatrix pomifoliella* Busck, Proc. Ent. Soc. Wash. V: 205.

1922. Snodgrass, R. E. The ribbed-cocoon maker of the apple. Report Smithsonian Institution, 1920, pp. 496-509, Plates 2 and 3.

1923. *Bucculatrix pomifoliella* Forbes, Mem. 68, Cornell Univ. Agric. Exp. Sta., p. 158.

1925. *Bucculatrix pomifoliella* Braun, Trans. Amer. Ent. Soc. LI: 222.

1947. *Bucculatrix pomifoliella* Comstock, An Introduction to Entomology, p. 616.

1869. *Lithocolletis curvilineatella* Packard, Guide Stud. Ins., p. 354. [Type, M.C.Z.].

1880. *Bucculatrix pomonella* Packard, Guide Stud. Ins., 7th ed., p. 354.

Additional references to this species have appeared in the economic literature.

Face creamy white, minutely brown-speckled except in the palest specimens, tuft varying from white with a few brown hairs centrally to predominantly brown, with only the front and a few lateral hairs whitish; eye-caps creamy white, typically minutely brown-speckled and posteriorly slightly brown-shaded; antennal stalk in basal two-thirds evenly and regularly annulate with alternating white and brown rings, in apical third one longer and a second shorter dark brown section are separated from the evenly annulate basal two-thirds and apex and from one another by white rings. Thorax white with minute faint brown speckling, or densely brown dusted. Basic ground color of the fore wings creamy white, more or less obscured by the slight to dense dark dusting of brown-tipped scales; in general the basal half of the wing is paler than the outer half, sometimes contrastingly so; a line of dark scales along costal margin is deflected at one-third forming a short oblique wedge-shaped mark; similar lines of dark scales lie along the fold and along base of dorsum; from middle of costa an oblique streak, darkest and broadest on costa, crosses the wing to termen just above tornus, and is irregularly margined outwardly with blackish scales; this streak sometimes fades out before reaching termen; on middle of dorsum a conspicuous dark brown oval spot, sometimes encircled by whitish scales, bears a patch of blackish raised scales near its inner edge; a dark brown apical spot, typically preceded by a pale half ring, which may be obscured by dark dusting; a line of dark-tipped scales in cilia from apex to tornus. Hind wings and cilia pale to dark grayish ochereous. Legs creamy white, with some fuscous shading and fuscous-tipped tarsal segments. Abdomen whitish to dark fuscous.

Alar expanse 7 to 7.5 mm.

Male genitalia (figs. 228, 228a, 228b, 228c). Harpes with slight indication of lobes, but the parts fused and strongly sclerotized, the apex dark-pigmented (fig. 228a), thus in ventral view concealing the thin membranous socii (fig. 228b); vinculum greatly produced anteriorly to an acute rounded point and expanded at base into lateral wings, the outer margins of which are continuous with the tegumen; aedeagus (fig. 228c) enormous, tapering from the swollen base to acute tip, aperture elongate, cornuti a line of closely placed short spines. Scale sac broad and shallow, scales short.

Female genitalia (figs. 229, 229a). Ductus bursae sclerotized through segment 7, expanding before ostium, its ventral margin produced posteriorly to an acute angle; inception of ductus seminalis at anterior end of expanded section; signum longitudinally placed, obsolete dorsally, ribs diverging, a series of short acute spines on swollen bases.

Specimens examined.—approximately 75, representing both sexes.

PENNSYLVANIA: Easton, ♀ type [A.N.S.P.]; Arendtsville, 1 ♂, issued 5-22-1922 (S. W. Frost) [J. R. Eyer Coll.]; Oak Station, Allegheny County, 1 ♂, May 8 (Fred Marloff) [Cornell U.].

VIRGINIA: Winchester, 1 (sex not determined), April 17, 1905 (Aug. Busck) [U.S.N.M.].

NEW JERSEY: Montclair and Essex County, 8, ♂, ♀ (WDK) [U.S.N.M.]; New Lisbon, 11, ♂, ♀, May and June dates, "bark of apple"; 1 ♂, "on wild cherry," July 22, 1935 (Darlington Coll.) [A.N.S.P.].

NEW YORK: Ithaca, 2 ♂, 1 ♀, Comstock, No. 110 [J. R. Eyer Coll.]; Monroe County, 1 ♀, May 1945 "ex hickory" (cocoon on bark) [C. P. Kimball Coll.]; Gardenville, 1 ♂, March 14 [Cornell U.].

MASSACHUSETTS: Barnstable, 2 ♂, 3 ♀, June 26 to August 11 [C. P. Kimball Coll.].

MAINE: Augusta, a few specimens in poor condition [A. E. Brower Coll.].

ONTARIO: Ottawa, 1 ♂, on *Crataegus* sp., with cocoon (55-104A), 20.VI.1956 (G. G. Lewis) [C.N.Coll.].

OHIO: Cincinnati, 1 ♂, 4 ♀, rearing record B.477 (on *Prunus serotina* Ehrh.), imagoes June 29 to July 25 (A. F. Braun) [A.F.B.Coll.]; 1 ♀, rearing record B.477, emerged July 19, 1913 (A. F. Braun) [A.N.S.P.]; 1 ♂, on plum, April 28, 1918 (A. F. Braun), 1 ♂, May 9, 1912 (A. F. Braun) [A.F.B.Coll.]; Beaver Pond, Adams County, rearing record B.2190 (on apple), imago April 19, 1954; 1 ♂, May 3, 1930 (A. F. Braun) [A.F.B.Coll.].

TENNESSEE: Great Smoky Mountains National Park, Appalachian Trail, 5200 feet, 1 ♂, 1 ♀, rearing record B.2200 (on *Amelanchier laevis* Wieg.), imagoes April 25, 26, 1954 (A. F. Braun) [A.F.B.Coll.].

NORTH CAROLINA: Great Smoky Mountains, Dock's Gap, 4930 feet, 1 ♀, rearing record B.2195 (on *Amelanchier laevis* Wieg.), imago April 25, 1954 (A. F. Braun) [A.F.B.Coll.]; Highlands, Macon County, 3865 feet, 1 ♀, June 29, 1958, collected as part of a project sponsored by the American Philosophical Society (R. W. Hodges) [Cornell U.].

MISSOURI: Kirkwood, 2 ♀, April 2, 1894 (erroneously labeled *ambrosiaefoliella*), show the characteristic antennal markings of *pomifoliella* [U.S.N.M.]; 1 ♀, April 15 (Murtfeldt Coll.) [Cornell U.].

UTAH: Logan Canyon, Cache County, 5500 feet, 3 ♂, 8 ♀, rearing record B.1181 (on *Physocarpus malvaceus* Kuntze), imagoes March 12 to April 15, 1925 (A. F. Braun) [A.F.B.Coll.].

WASHINGTON: Pullman, 1 ♂, 1 ♀, 19.VI.33 (J. F. Clarke) [U.S.N.M.].

BRITISH COLUMBIA: Victoria, 1 (sex not determined) [E. H. Blackmore]; 1 ♂, 24.6.1923 (W. R. Carter) [U.S.N.M.]; Seton Lake, Lillooet, 1 ♀, 6.VI.1926 (J. McDunnough) [C.N.Coll.].

No LOCALITY: a long series glued on cards, No. 48x; one pinned specimen, iss. April 6, 1883 (Riley Collection) [U.S.N.M.]; 2 from the Fernald collection without locality label [U.S.N.M.]. Associated with the series on cards and also bearing the number 48x, and labeled "*Bucculatrix pom.*" is a twig crowded with cocoons, all of which are white.

As indicated by the above records, the native food plants include a number of tree and shrub members of the Rosaceae. The economic importance of *B. pomifoliella* resulted with the transfer to apple as a food

plant and consequent great increase in abundance. The crowding of cocoons on twigs of apple (see figure in Comstock) has no counterpart on native food plants.

The egg is deposited on the lower surface of the leaf next to the midrib; the fine linear mine in its early course follows the midrib, then diverges from it; the length is dependent on the thickness of the leaf. The larva leaves the mine through the upper epidermis, spinning its moulting cocoons commonly on the upper side of the leaf, sometimes on the underside. The exposed larva, green shaded with red, feeds with rare exceptions on the upper side of the leaf, eating out irregular patches, but leaving the lower epidermis intact, which then shows as an iridescent patch. These iridescent patches are characteristic evidence of the presence of larvae of *B. pomifoliella*.

The cocoon, of the usual ribbed type common to the genus, is spun upon a twig or other convenient surface; it is slender elongate, with seven or eight well-defined ridges. Its color varies with the food plant; on apple the cocoons are white or whitish; on *Amelanchier* and *Physocarpus* pale tannish ochereous; on *Prunus serotina* reddish brown; the single cocoon on *Crataegus* is dark brown. Except in the North, there are two generations in a year.

The imagoes vary greatly in different parts of their range; western specimens are uniformly paler than eastern specimens and may lack almost entirely any dark dusting in the basal half of the wing. Genital slides demonstrate the specific identity.

The characteristic genitalia of both sexes separate *B. pomifoliella* from all other described species, and are constant for the species throughout its range, except for some variation in the length of the aedeagus. Its close relationship to the European *B. crataegi* Zeller is indicated by the genitalia, which resemble those of *crataegi*, but show a greater degree of fusion and sclerotization as well as other obvious differences.

SECTION VII

Species 95

A single species, *Bucculatrix ilcella* Busck, characterized in the male by the lobed harpes, the well-defined gnathos, and the reduced socii, and in the female by the unusual signum (fig. 231), constitutes this section.

(95) *Bucculatrix ilecella* Busck (Figs. 231, 232, 232a.)

1915. *Bucculatrix ilecella* Busck, Proc. Ent. Soc. Wash. XVII: 91. Type ♀, Victoria, Texas [U.S.N.M., Type No. 19248].

Face white, finely speckled with grayish fuscous-tipped scales; tuft white, mixed with ochreous fuscous; eye-caps white, dotted with fuscous, antennal stalk white with dark gray or brown annulations. Thorax and fore wings white, the ground color more or less obscured by the dusting of minutely to broadly dark-tipped scales; aggregations of the more broadly dark-tipped scales form the ill-defined markings; such a group of scales lies along costa near base and is more or less distinctly connected with an elongate patch of such scales in the fold beyond which are two or three ill-defined groups of scales in the fold; from middle of costa, and only distinct near costa is an oblique cross-band; from two-thirds of costa, an oblique band, broad on costa and there forming the best-defined mark on the wing, crosses the wing; dark scales in the apex tending to separate into cross lines; a line of black-tipped scales in the cilia. Hind wings pale silvery gray in female, darker gray in male. Legs white, hind tibiae dark fuscous outwardly, with an oblique white bar near middle, tarsal segments broadly fuscous-tipped. Abdomen silvery fuscous above, silvery white beneath.

Alar expanse 4 to 4.4 mm.

Male genitalia (figs. 232, 232a). Harpes bilobed, divided almost to base, a broad oval ventral lobe clothed with decumbent setae, and a very slender dorsal lobe, setose on its outer half; gnathos present, consisting of two slender arms joined at an obtuse angle; socii reduced to minute blunt protuberances; aedeagus stout, cornuti minute, numerous; vinculum broad. Scale sac minute.

Female genitalia (fig. 231). Ostium in membrane at anterior margin of segment 8; ductus bursae short, with lateral sclerotization before ostium; bursa copulatrix in segments 5 and 6, relatively small, its posterior half globose, with entrance of ductus bursae posterior and ventral; signum a series of radiating dentate lines, converging posteriorly and extending into the ductus for nearly one-third its length.

Specimens examined.—3 ♂, 6 ♀.

TEXAS: Victoria, ♀ type, ♀ "cotype," on *Ilex* sp., "holly," July (W. D. Hunter) [U.S.N.M.]; Brownsville, 3 ♂, 4 ♀, "reared from Wild Shrub," April 4-17, 1933 (T. C. Barber) [U.S.N.M.].

One or more of the deciduous species of *Ilex*, several of which occur in Texas, are the food plants of *ilecella*. The cocoons are pure white, rounded at each end, 4 to 5 mm. in length, with seven sharply defined ridges. Apparently there are two generations a year.

The material from Brownsville, Texas makes possible the amplification of the original description of the species by Busck. In the Brownsville series, the markings are darker and more clearly defined than in

the type, with an additional patch of dark scales extending onto the disc, represented in the type by dark scales on the costal margin only. A genitalia slide of a female of this series agrees exactly with the slide of the type [Clarke No. 10413].

The characteristic genitalia easily enable recognition of this minute species.

SECTION VIII

Species 96 to 99

Included in Section VIII are four species of our fauna, feeding in the larval state on members of the plant family Malvaceae. These species are characterized by unusual and unique features of the genitalia of both sexes. Chief of these are, in the male, the lobed harpes and the tendency for the development of sclerotized plates of the sternite or of both sternite and tergite of the eighth abdominal segment; these plates may extend as free arms. In the female, the characteristic features are the position of the ostium at the posterior margin of the sclerotized basal half of segment 8, the development of a second pair of apophyses, those of the eighth segment, and perhaps most unique and distinctive, the presence of a dorso-lateral group of setae on a sclerotized area at the base of the membranous posterior half of segment 8. These characters are also present in the Mediterranean *Bucculatrix lavaterella* Milliere, which indicates early separation from ancestral stock and a long period of differentiation and specialization of the species of this section.

Although the wing markings of the species of this section conform to the general pattern of the genus, it may be possible to recognize a species of this section by the grouping of clusters of dark or dark-tipped scales to form four costal patches, about equally spaced, the first at or near the base of the wing (cf. figures 7 and 13).

(96) ***Bucculatrix quadrigemina*** Braun

(Figs. 22, 35, 235, 235a, 236, 236a, 236b.)

1918. *Bucculatrix quadrigemina* Braun, Ent. News XXIX: 247. Type ♂, Loma Linda, San Bernardino County, California [A.F.B.Coll.].

1919. *Bucculatrix althaeae* Busck, Proc. Ent. Soc. Wash. XXI: 109. Type, Stanford University, California [U.S.N.M., Type No. 22195]. **New synonymy.**

Face whitish, often faintly shaded with pale fuscous-ocherous, tuft whitish, with pale fawn or brownish hairs intermixed; eye-caps straw colored to pale brown, antennal stalk straw colored, with dark brown annulations. Thorax straw colored, microscopically dusted with brown, tegulae more conspicuously brown-dotted. Fore wings creamy white more or less yellow or ocherous tinged, especially below fold, and except for the white oblique costal streaks separating the patches of ocherous brown-tipped scales, more or less dusted with minutely brown-tipped scales; in the type series of *quadrigemina* and in some of the specimens in the U.S.N.M. from San Bernardino County and San Diego, the ground color below the fold is scarcely or not at all dusted; four large costal patches of ocherous brown-tipped scales, the first at base of wing, the second at one-third, the third, the broadest, at middle of costa, the fourth before apex and separated from it by a whitish streak of ground color; these patches become indistinct toward the middle of the wing and blend with the more ocherous ground color below fold; on middle of dorsum, a patch of more broadly brown-tipped scales bears on its inner margin and just within the dorsal margin a large patch of black-tipped raised scales; at tornus, a whitish streak, defined outwardly by more conspicuously dark brown-tipped scales which join the fourth costal patch; a few dark scales at extreme apex; cilia pale fuscous-stramineous, opposite apex with a line of dark-tipped scales, which is continued as a broken line to tornus. Hind wings and cilia pale to dark fuscous. Legs grayish buff, with dark brown-tipped tarsal segments. Abdomen fuscous, with stramineous anal tuft.

Alar expanse 7 to 8 mm. (*quadrigemina*); 9 to 10 mm. (*althaeae*).

Male genitalia (figs. 235, 235a). Sternite of eighth abdominal segment a strongly sclerotized plate produced posteriorly into two free arms, which project to the tip of the harpes; harpe with semicircular minutely setose ventral lobe, slender tip of harpe curving ventrad; socii very small, arising from the incurved tegumen; subscaphium defined; anellus broad at base curving to a slender tube apically; aedeagus long, broad at base, constricted in middle, thence slender double-curved; vinculum truncate anteriorly, with a mid-ventral strong sclerotized dorso-ventral plate. Scale sac small, scales long, linear, pointed.

Female genitalia (figs. 236, 236a, 236b). Anterior apophyses, lateral outgrowths of the strongly sclerotized anterior half of segment 8, present; tergite of segment 8 with two anteriorly projecting lobes, and dorsad of lateral line with tuft of hair-like scales directed obliquely posteriorly and toward median line; ostium opening at the posterior margin of the strongly sclerotized anterior half of the eighth segment; ductus bursae sclerotized immediately before ostium; signum ribs slender, spines long acicular (fig. 236b).

Specimens examined.—47, representing both sexes.

CALIFORNIA: Loma Linda, ♂ type, June 25, 2 ♂, 1 ♀ paratypes, June 18 to 30, 1912 (G. R. Pilate) [A.F.B.Coll.]; 2 ♂, 1 ♀, June and September [U.S.N.M.]; San Diego, 2 ♂, 1 ♀, [U.S.N.M.]; Stanford University, type of *althaeae*, Dec. 20, 1918, "on hollyhock" (labeled in U.S.N.M. *isabella* Type)

[U.S.N.M.]; 3 cotypes, Dec. 20, 1918, 5 cotypes, ♂, ♀, Feb. 10, 1919 [U.S.N.M.]; 2 ♀, Feb. 10, 1919 [A.F.B.Coll.]; Ventura, 4, ♂, ♀, X.1.14 (S. H. Essig) [U.S.N.M.]; Berkeley, 5 ♂, ♀, December 11-18, 1925 (W. W. Jones) [U.S.N.M.]; Berkeley, 5 ♂, 4 ♀, rearing record B.992, imagoes October, 1918; 5 ♂, 2 ♀, December, 1924 [A.F.B.Coll.]; 1 ♂, December, 1924 [A.N.S.P.].

This species has been reared in large numbers from the cultivated hollyhock (*Althaea rosea* Cav.); its native food plant is not known, but will be found to be some related malvaceous plant of the semi-arid regions of southern California. With the transfer to the more succulent hollyhock as a food plant, considerable increase in size resulted, as evidenced by the greater expanse. Misled by the larger size and heavier dark dusting, Busck described the hollyhock-feeder as a new species (*althaeae*) closely related to *quadrigemina*. The unique genitalia, identical in both series, prove the synonymy.

The egg (fig. 35) deposited on the lower surface of the leaf is ellipsoidal, reticulate, the ridges converging somewhat toward the micropylar end.

When present in large numbers, the very long linear mines, fine thread-like in the early part, cross and recross one another; the leaf is riddled with holes by the external feeding larvae. I quote the following description of the larva (*l.c.* p. 110): "The free feeding mature caterpillar is 6 mm. long. Head light yellow with black continuous eyespots. Thoracic shield light gray with numerous (20) small black dots. Body light gray with darker gray transverse band across each joint, on which the large whitish tubercles stand out prominently. Setae blackish. Legs gray with two transverse darker lines and with last joint yellow. Abdominal legs well developed, normal in number, each with two posterior and one anterior crotchet. Anal legs with but one crotchet.

"Cocoon 5 mm. long, white, with a yellowish tint, loosely woven with but slight indicated longitudinal ridges." An occasional cocoon shows well-defined, but very low fine ridges.

(97) **Bucculatrix gossypiella** Morrill (Figs. 233, 233a, 233b, 234, 234a.)

1927. *Bucculatrix gossypiella* Morrill, Proc. Ent. Soc. Wash. V: 94-97. Type ♂, Cajeme, Sonora, Mexico [U.S.N.M., Type No. 40380].

1927. Observations on *Bucculatrix gossypiella*, a new and important cotton pest. Morrill, A. W., Journ. Econ. Ent. 20: 536-544. [3 plates, showing work of larvae on cotton.]

The type has the wings folded upward with the upper surfaces tightly appressed, and it is not possible to see the wing markings. I quote Morrill's brief description of the moth:

"Face, tuft, head and thorax white. Fore wings white with black and light brown scale markings, cilia ochreous white. Hind wings and cilia ochreous white. Coloration closely similar to adults of *Bucculatrix thurberiella* Busck" . . .

"Alar expanse.—5 to 8 mm."

Additional type material in the United States National Museum is not in sufficiently good condition to supplement the above description, nor to compare *B. gossypiella* with *B. thurberiella*.

Male genitalia (figs. 233, 233a, 233b). Harpe with a median lobe, curving to acute tip, with several very long setae; cucullus oval when viewed dorso-ventrally, acute when rotated to show inner surface (fig. 233a), and long setose distad of the lobe; socii rounded, approximate; anellus cordate, minutely spinulose; aedeagus long, gradually tapering, cornuti a mass of minute spines; vinculum greatly expanded, produced anteriorly. Scale sac bilobed, similar to that of *thurberiella*.

Female genitalia (figs. 234, 234a). Anterior portion of segment 8 strongly sclerotized and prolonged to form the slender anterior apophyses; oval pockets on lateral margins; ostium at the posterior margin of the sclerotized section of segment 8; signum open ventrally, very narrow dorsally, composed of contiguous parallel rows of acute spines arising from swollen bases (fig. 234a).

In the paper in the Journal of Economic Entomology, Morrill gives a detailed account of the habits of the larvae, including the characters separating this species from *B. thurberiella* in its early stages. I quote a few excerpts from this paper. "The egg of *B. thurberiella*. . . is elongated, projectile shaped with about 10 projecting ridges and stands perpendicular to the leaf. The egg of *B. gossypiella* is flattened, scale like, has as a rule five longitudinal ridges converging toward the micropylar end." . . . "The larvae of *B. gossypiella* have the peculiar habit of boring in woody or hard tissues of the plant, such as stalks, branches . . . leaf petioles, and larger leaf veins as well as in the leaf blades and bracts . . .". "Occasionally a blotch like or trumpet shaped mine is produced in the leaf tissue but never, as far as observed, a clear cut serpentine leaf mine similar to that made by *B. thurberiella*." Cotton stems in the United States National Museum show a mined circular area similar to that noted by Morrill in the leaf blade.

This species, not so far recorded north of Mexico, is included here because of the possibility of its introduction.

(98) **Bucculatrix sphaeralceae** new species

(Figs. 7, 237, 237a, 237b, 237c, 238, 238a.)

Face white, tuft white with a few pale yellow hairs on vertex; eye-caps white, the projecting hair-scales concealing the antennal notch of the male in the short first segment of the flagellum; antennal stalk white, with pale brown annulations. Thorax white, pale yellow anteriorly, with a few brown-tipped scales. Fore wing (fig. 7) white; markings pale yellow-ocherous, the scales more or less brown or blackish tipped; four costal patches of such scales, the first near base, inconspicuous and lying along costa, the second at one-third extends obliquely outward, becoming obsolescent before reaching the middle of the disc, the third, the largest, at middle of costa, may continue across the wing to termen as a slender pale yellowish line, marked at end of cell by a few (1-4) black scales, and on termen by a few black-tipped scales; the fourth in the apical third is separated from the apex by a patch of white ground color and between it and the third patch the costa is marked with dark-tipped scales; a pale ocherous shade in the fold (sometimes scarcely distinguishable) from near base to one-third is marked with a few black-tipped scales; this shade sometimes expands by minutely dark-tipped scales to costa and to dorsum, and may bear a few black raised scales; on middle of dorsum a patch of pale yellow, dark-tipped scales, on the inner border of which below fold is a small group of black raised scales; this patch may equal in size the third costal patch or be reduced to an almost imperceptible yellowish shade, marked only by a few raised black scales; a few dark-tipped scales at extreme apex and a broken line of dark-tipped scales extending through the white cilia. Hind wings and cilia white, very faintly ocherous tinged. Legs white, inner side of anterior tibiae marked with a series of fine dark transverse lines; tarsal segments sometimes dark-tipped. Abdomen white.

Alar expanse 6.5 mm. (Texas specimens) to 9.5 mm. (California specimens).

Male genitalia (figs. 237, 237a, 237b, 237c). Posterior ventral margin of segment 8 strongly sclerotized and projecting over vinculum, a median broad lobe, lateral lobes curving dorsad and clasping vinculum; harpe with a long slender inward lobe directed posteriorly, cucullus gradually tapering and margined with rows of short heavy setae; gnathos, two outwardly curved bodies fringed with branched hairs; socii, flat circular pads clothed with long decumbent hairs; anellus flask-shaped; aedeagus long, swollen at base, soon slender; vinculum evenly rounded. No scale sac.

Female genitalia (figs. 238, 238a). Basal half of segment 8 strongly sclerotized, its lateral margins prolonged forward in the abdomen to form the anterior apophyses; ductus bursae opening into an asymmetric greatly expanded sclerotized chamber nearly the width of the segment; laterally, in a depression at the base of the membranous posterior half of segment 8, a group of long setae directed obliquely toward mid-dorsum; ductus bursae before ostium minutely dentate; signum ring narrow, very obliquely placed, the spines arranged in parallel groups (fig. 238a).

Type.—♂, Presidio, Texas, "ex *Sphaeralcea*, Oct. 18, 1939, em. Oct. 30, 1939" (J. R. Russell) [U.S.N.M., Type No. 65037].

Allotype.—♀, same data as the type.

Paratypes.—1 ♀, same data as the type, except date of emergence Nov. 3, 1939; 5 ♂, 1 ♀, Presidio, Texas, "material placed in rearing jar 13 Oct. 1954. Moths found dead 11 Jan. 1955" (J. R. Russell) [U.S.N.M.]; 1 ♂, San Benito, Texas, March 24–30 (H. S. Barber) [U.S.N.M.]; 2 ♀, Brownsville, Texas, VI.04 (H. S. Barber) [U.S.N.M.]; 1 ♂, 2 ♀, Blythe, California, "Bred Malva," Oct. 18–27, 1934 (C. Dammers) [U.S.N.M.]; 1 ♂, "Borrego V., S. Diego Co., Calif., bred from Malva, April 13, 1936" (C. Dammers) [U.S.N.M.].

The three paratypes from Blythe, California are in such condition as to be unrecognizable except by genitalia, but are included in the type series for the value of the distribution data.

The type of markings—four costal patches, the first near base of costa—is typical of the group of species feeding on Malvaceae. The remarkable and unique genitalia separate this species from all others of our fauna.

(99) ***Bucculatrix thurberiella*** Busck

(Figs. 13, 23, 239, 239a, 239b, 239c, 239d, 239e, 240, 240a, 240b.)

1914. *Bucculatrix thurberiella* Busck, Proc. Ent. Soc. Wash. XVI: 30. Type ♂, genitalia slide 9942, J. F. G. C., allotype ♀, genitalia slide 9943, J. F. G. C., Santa Catalina Mountains, Arizona [U.S.N.M., Type No. 16699].
1916. *Bucculatrix thurberiella*, A Pest of Cotton in the Imperial Valley. McGregor, E. A. Journ. Econ. Ent. 9: 505–510. Plates 36, 37.
1927. *Bucculatrix thurberiella* Morrill, Journ. Econ. Ent. 20: 536–544.

Face white, tuft white with an occasional grayish hair; eye-caps white, antennal notch very shallow, stalk with fuscous annulations. Thorax white. Fore wing (fig. 13) white; extreme costal margin from base to beyond middle blackish, the black scales projecting onto the wing near base as a narrow elongate patch, at one-third as a slightly larger and oblique patch, near middle of wing as a conspicuous irregular patch which continues as a fine line (sometimes obsolete) obliquely across the wing to a conspicuous patch of blackish scales on termen which continues along termen in an irregular line to apex; beyond this the cilia are dotted with black-tipped scales; a more even short line of scales in cilia near apex; cilia on termen immediately below apex often blackish; apical costal half of wing beyond the oblique streak dusted with paler brown and blackish-tipped scales; a few black-tipped scales below fold near base; a group of black scales just within the dorsal margin and on fold is followed by scattered brown scales. Hind wings and cilia pale whitish ochereous. Legs pale whitish ochereous inwardly, blackish fuscous outwardly, hairs of posterior tibiae white, tarsal segments white at base.

Alar expanse 7 to 8 mm., 9 mm. in some of the cotton-feeding specimens.

Male genitalia (figs. 239, 239a, 239b, 239c, 239d, 239e, all figures to the same scale). Both tergite and sternite of segment 8 modified into specialized plates; sternite prolonged into two long slender prongs, the right prong the longer, laterally with two rounded lobes curving dorsad; the tergite a large flat plate terminating in two black pillars—masses of fused-together setae; prongs of both sternite and tergite exceeding the genitalia; harpe (fig. 239a) with a stout costal lobe terminating in heavy setae, below tip with three long and several short setae, cucullus with short setae; sacculus produced as a sharp pointed process; socii slender, erect, widely separated; anellus ovoid; aedeagus long, gradually tapering; vinculum an equilateral triangle. Scale sac bilobed, scales slender, forked.

Female genitalia (figs. 240, 240a, 240b). Segment 8 strongly sclerotized except for a narrow posterior band, lateral margins produced anteriorly into curved processes, appearing as rudimentary apophyses; raised pockets on lateral margins; two short setae on a dorso-lateral sclerotized surface of the membranous posterior part of segment 8 (fig. 240a); ostium flaring, opening at the posterior margin of the sclerotized section of segment 8; signum faint, a mass of minute spines on a weakly sclerotized surface (fig. 240b).

Specimens examined.—approximately 125 including the type series on *Thurberia thespesioides* Gray and large series reared on cotton.

ARIZONA: Pima Canyon, Santa Catalina Mountains, August and September, 1913, type and allotype, and several paratypes, not all in good condition, all reared on *Thurberia thespesioides* Gray, together with ♂ and ♀ genitalia slides from type material by Busck and Clarke; Mesa, 44, ♂, ♀, "bred from Pima cotton bolls and leaves," November 1930 to January 1931 (H. C. Young); Tucson, 55, ♂, ♀, with cocoons, "on cotton" with dates of emergence July and August (L. J. Bottimer) [U.S.N.M.]; Madera Canyon, 4880 feet, Santa Rita Mountains, 5 ♂, 3 ♀, August 23–27 (R. W. Hodges) [Cornell U.].

CALIFORNIA: Calexico, 8 ♂, ♀, July 14–15, 1931, "on cotton," with pressed leaves showing larval work (T. C. Barber); same locality, ♂, ♀ (O. A. Pratt and T. P. Cassidy) [U.S.N.M.].

TEXAS: San Benito, 1 ♂, 1 ♀, April 1–7 [U.S.N.M.]; 1 ♂, 1 ♀, "on cotton," 7.VIII.35 [C.N.Coll.].

In addition to the above records, five specimens in the United States National Museum from South America labeled "Lima" are identified (AB) as *B. thurberiella*.

The pressed cotton leaves show a short linear mine and eaten patches. Busck (*l.c.*) gives the following description of the larva and cocoon on *Thurberia*: "The larva is dirty white, rough skinned, with prominent white tubercles and with two dorsal rows of black dots, one

on each segment. Head light ochreous with black eye spots and reddish brown mouth parts.

"Cocoon ribbed, typical of the genus, pearly white, length 8-9 mm." The cocoon is slender with eight to ten ridges, not always well-defined.

Specimens reared on cotton often surpass in wing expanse the moths of the type series, but, as shown by genitalia, are identical with those reared on the native food plant, *Thurberia thespesioides* Gray. The only species which *B. thurberiella* resembles in markings is the Mexican *B. gossypiella* Morrill, from which it is easily separated by genitalia of both sexes; *B. thurberiella* is further distinguished from *B. gossypiella* by the erect ridged egg and the linear serpentine mine in the leaves or bolls.

McGregor (*l.c.*) notes that the cocoon is surrounded by a "palisade." He raises the question as to whether *Thurberia* is the original food plant and suggests that "the insect has found its way to the United States from the ancient cotton-growing areas of Mexico and from the insular and maritime regions of tropical America to which cotton is indigenous." It should perhaps be noted that *Thurberia thespesioides* Gray is, by some authors, included in *Gossypium* as *Gossypium thurberi* Todaro.

LIST OF THE NORTH AMERICAN SPECIES OF BUCCULATRIX
(*Synonyms in italics*)

Bucculatrix Zeller

Ceroclastis Zeller

- | | |
|--|--------------------------------|
| 1. fusicola Braun | 32. agnella Clemens |
| 2. solidaginiella new species | <i>capitealbella</i> Chambers |
| 3. montana Braun | <i>capitilbella</i> Chambers |
| 4. magnella Chambers | <i>albicapitella</i> Chambers |
| 5. needhami Braun | 33. kimballi new species |
| 6. longula new species | 34. ivella Busck |
| 7. simulans new species | 35. ambrosiaefoliella Chambers |
| <i>fusicola</i> Breland and Schmitt | <i>rileyi</i> Frey and Boll |
| (not Braun) | 36. pallidula new species |
| 8. niveella Chambers | 37. taeniola new species |
| 9. parvinotata new species | 38. carolinae new species |
| 10. ochritincta new species | 39. angustata Frey and Boll |
| 11. viguierae new species | <i>crescentella</i> Braun |
| 12. micropunctata new species | 40. adelpha new species |
| 13. inusitata new species | 41. plucheae new species |
| 14. seneciensis new species | 42. eupatoriella Braun |
| 15. bicristata new species | 43. polynniae new species |
| 16. cuneigera Meyrick | 44. speciosa new species |
| <i>errans</i> Braun | 45. subnitens Walsingham |
| 17. albaciliella Braun | 46. sexnotata Braun |
| 18. ochristrigella Braun | 47. divisa Braun |
| 19. eurotiella Walsingham | 48. illecebrosa new species |
| <i>chrysothamni</i> Braun | 49. insolita Braun |
| 20. tenebricosa Braun | 50. transversata Braun |
| 21. ericameriae new species | 51. koebelilla Busck |
| 22. variabilis Braun | 52. saluatoria Braun |
| 23. separabilis new species | 53. leptalea new species |
| <i>variabilis</i> Braun (in part) | 54. arnicella Braun |
| 24. brunnescens new species | 55. tridenticola new species |
| 25. evanescens new species | 56. spectabilis new species |
| 26. benenotata new species | 57. seorsa new species |
| 27. floccosa Braun | 58. angustisquamella Braun |
| 28. flourensiae new species | 59. columbiana new species |
| 29. franseriae new species | 60. sororcula new species |
| 30. staintonella Chambers | 61. nigripunctella Braun |
| <i>albella</i> Chambers (not Stainton) | 62. atosignata new species |
| <i>pertenuis</i> Braun | 63. enceliae new species |
| 31. immaculatella Chambers | 64. latella Braun |

- | | |
|---|--|
| 65. sporobolella Busck | 83. fugitans Braun |
| 66. packardella Chambers | 84. callistricha new species |
| 67. albertiella Busck | 85. eugrapha new species |
| <i>tetrella</i> Braun | 86. cerina new species |
| 68. coniforma new species | 87. copeuta Meyrick |
| 69. platyphylla new species | 88. locuples Meyrick |
| 70. ochrisuffusa new species | 89. ainsliella Murtfeldt |
| 71. trifasciella Clemens | 90. eclecta new species |
| <i>obscurofasciella</i> Chambers | 91. anaticula new species |
| 72. quinquenotella Chambers | 92. disjuncta new species |
| 73. domicola new species | 93. ceanothiella Braun |
| 74. zophopasta new species | 94. pomifoliella Clemens |
| 75. litigiosella Zeller | <i>curvilineatella</i> (Packard) (as |
| 76. coronatella Clemens | <i>Lithocolletis curvilineatella</i>) |
| 77. canadensisella Chambers | <i>pomonella</i> Packard |
| 78. improvisa new species | 95. ilecella Busck |
| 79. polytita new species | 96. quadrigemina Braun |
| 80. luteella Chambers | <i>althaeae</i> Busck |
| 81. recognita new species | 97. gossypiella Morrill |
| <i>litigiosella</i> Forbes (not Zeller) | 98. sphaeralceae new species |
| 82. paroptila new species | 99. thurberiella Busck |

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EXPLANATION OF FIGURES

Plate I

The line represents 1 mm.

- Fig. 1.—*Bucculatrix solidaginiella* new species, paratype, front view of head of male; eye-cap (scape), pedicel and two segments of flagellum shown; note antennal notch in first segment of flagellum. Cincinnati, Ohio.
- Fig. 2.—*Bucculatrix solidaginiella* new species, paratype, eye-cap (scape), pedicel and two segments of flagellum of female. Cincinnati, Ohio.
- Fig. 3.—*Bucculatrix fusicola* Braun, fore wing (female). Cincinnati, Ohio.
- Fig. 4.—*Bucculatrix viguierae* new species, allotype, fore wing. Sierra County, New Mexico.
- Fig. 5.—*Bucculatrix needhami* Braun, paratype, fore wing (male). Glades County, Florida.
- Fig. 6.—*Bucculatrix magnella* Chambers, paratype, fore wing (male). Texas.

Plate II

Wing Pattern of Fore Wings

The line represents 1 mm.

- Fig. 7.—*Bucculatrix sphaeralceae* new species, allotype. Presidio, Texas.
- Fig. 8.—*Bucculatrix copeuta* Meyrick. Sparrow Lake, Ontario.
- Fig. 9.—*Bucculatrix polymniae* new species, paratype. Highland County, Ohio.
- Fig. 10.—*Bucculatrix illecebrosa* new species, type. Colfax, Placer County, California.
- Fig. 11.—*Bucculatrix taeniola* new species, type. Salinas, California.
- Fig. 12.—*Bucculatrix saluatoria* Braun. Lillooet, British Columbia.
- Fig. 13.—*Bucculatrix thurberiella* Busck. Mesa, Arizona.
- Fig. 14.—*Bucculatrix leptalea* new species, paratype. Whitman County, Washington.
- Fig. 15.—*Bucculatrix trifasciella* Clemens, fore wing of male (compared with type). Cincinnati, Ohio.
- Fig. 16.—*Bucculatrix trifasciella* Clemens, fore wing of female. Cincinnati, Ohio.
- Fig. 17.—*Bucculatrix callistricha* new species, allotype. Beaver Pond, Adams County, Ohio.
- Fig. 18.—*Bucculatrix fugitans* Braun. Scioto County, Ohio.

Plate III

Venation

- Fig. 19.—*Bucculatrix ainsliella* Murtfeldt, female; 19a, tip of fore wing, male. Essex County Park, New Jersey.
- Fig. 20.—*Bucculatrix coronatella* Clemens, female. Floradale, Adams County, Pennsylvania.
- Fig. 21.—*Bucculatrix packardella* Chambers, female. Cincinnati, Ohio.
- Fig. 22.—*Bucculatrix quadrigemina* Braun, male. Berkeley, California.
- Fig. 23.—*Bucculatrix thurberiella* Busck, male. Tucson, Arizona.
- Fig. 24.—*Bucculatrix enceliae* new species, paratype, female. Palm Springs, California.
- Fig. 25.—*Bucculatrix eupatoriella* Braun, paratype, female. Cincinnati, Ohio.
- Fig. 26.—*Bucculatrix eupatoriella* Braun, paratype, male, fore wing. Cincinnati, Ohio.

Plate IV

Venation

- Fig. 27.—*Bucculatrix ochristrigella* Braun, paratype, female; frenulum magnified to show close association of the two frenulum spines. Alameda County, California.
- Fig. 28.—*Bucculatrix cuneigera* Meyrick, female. Cincinnati, Ohio.
- Fig. 29.—*Bucculatrix cuneigera* Meyrick, male. Cincinnati, Ohio.
- Fig. 30.—*Bucculatrix solidaginiella* new species, paratype, male; variation in venation shown in fig. 30a. Cincinnati, Ohio.

Plate V

The line represents 1 mm.

- Fig. 31.—*Bucculatrix needhami* Braun, last instar feeding larva; note single claw on thoracic legs. Englewood, Florida.
- Fig. 32.—*Bucculatrix trifasciella* Clemens, 5th instar larva. Cincinnati, Ohio.
- Fig. 33.—*Bucculatrix callistricha* new species, 8th, 9th and 10th abdominal segments of 5th instar larva, dorsal view. Beaver Pond, Adams County, Ohio.
- Fig. 34.—*Bucculatrix canadensisella* Chambers, setal pattern of 5th instar larva (after Friend).
- Fig. 35.—*Bucculatrix quadrigemina* Braun, egg shell ($\times 100$). Berkeley, California.
- Fig. 36.—*Bucculatrix polymniae* new species, egg shell ($\times 100$). Rowan County, Kentucky.
- Fig. 37.—*Bucculatrix callistricha* new species, egg shell ($\times 100$). Beaver Pond, Adams County, Ohio.

Plate VI

The line represents 1 mm.

- Fig. 38.—*Bucculatrix domicola* new species, pupa of male, dorsal view. Cincinnati, Ohio.
Fig. 39.—*Bucculatrix domicola* new species, pupa of male, ventral view. Cincinnati, Ohio.
Fig. 40.—*Bucculatrix domicola* new species, terminal segments of abdomen of pupa of female, ventral view. Cincinnati, Ohio.
Fig. 41.—*Bucculatrix fusicola* Braun, gall and cocoon on *Helianthus trachelifolius* Mill. ($\times 2$). Cincinnati, Ohio.
Fig. 42.—*Bucculatrix needhami* Braun, gall on *Helianthus agrestis* Pollard; 42a, cocoon ($\times 2$). Englewood, Florida.

Plate VII

The line represents 1 mm.

- Fig. 43.—*Bucculatrix sexnotata* Braun, mines and eaten patches on leaf of *Aster divaricatus* L. (natural size); 43a, cocoon. Great Smoky Mountains National Park, Tennessee.
Fig. 44.—*Bucculatrix cuneigera* Meyrick, mines on leaf of *Aster shortii* Lindl. (natural size); 44a, terminal portion of mine with overwintering cocoon ($\times 2$); 44b, cocoon. Cincinnati, Ohio.
Fig. 45.—*Bucculatrix angustata* Frey and Boll. Leaf of *Aster novae-angliae* L., showing work of a single larva: (1) linear mine, (2) small mines made by larva on leaving linear mine, (3) trumpet-shaped mines made in 4th and 5th instars, respectively ($\times 2$); 45a, cocoon. Cincinnati, Ohio.

Plate VIII

The line represents 1 mm.

- Fig. 46.—*Bucculatrix speciosa* new species; 46a, upper side of leaf of *Solidago* sp. with long linear mine and small eaten patches (natural size); 46b, underside of leaf with moulting cocoon and leaf patches eaten by 5th instar larva (natural size); 46c, cocoon. Cranberry Glades, Pocahontas County, West Virginia.
Fig. 47.—*Bucculatrix polynniae* new species, cocoon. Rowan County, Kentucky.
Fig. 48.—*Bucculatrix divisa* Braun; 48a, leaf-fragment showing early mine on *Balsamorhiza sagittata* (Pursh) Nutt. ($\times 2$); 48b, small Coleophora-like mines made by larva on leaving the early mine, underside of leaf as seen by transmitted light ($\times 2$); 48c, cocoon on underside of leaf of *Balsamorhiza sagittata*. Cache County, Utah.

- Fig. 49.—*Bucculatrix tridenticola* new species, cocoon on leaf of *Artemisia tridentata* Nutt. Logan, Utah.
- Fig. 50.—*Bucculatrix arnicella* Braun, cocoon. Logan Canyon, near Logan, Utah.
- Fig. 51.—*Bucculatrix saluatoria* Braun; leaf of *Artemisia tridentata* Nutt. (upper side) mined by 4th and 5th instar larva; 51a, cocoon on underside of leaf of *Artemisia tridentata*. Grand Teton National Park, Wyoming.

Plate IX

The line represents 1 mm.

- Fig. 52.—*Bucculatrix packardella* Chambers; 52a, mined leaf of *Quercus muehlenbergii* Engelm. (natural size); 52b, second moulting cocoon and eaten patch on underside of leaf ($\times 4$); 52c, cocoon on bark of tree. Cincinnati, Ohio.
- Fig. 53.—*Bucculatrix trifasciella* Clemens, cocoon on leaf of *Quercus bicolor* Willd. Cincinnati, Ohio.
- Fig. 54.—*Bucculatrix domicola* new species; 54a, mine on leaf of *Quercus shumardii* Buckl. (natural size); 54b, mine enlarged ($\times 4$); 54c, cocoon. Cincinnati, Ohio.
- Fig. 55.—*Bucculatrix fugitans* Braun; 55a, leaf of *Corylus americana* Walt., with mine and small eaten patches (natural size); 55b, feeding pattern of the last larval instar (natural size); 55c, cocoon. Scioto County, Ohio.
- Fig. 56.—*Bucculatrix pallidula* new species, mine of the type; 56a, cocoon. Zion Canyon, Utah.
- Fig. 57.—*Bucculatrix locuples* Meyrick, cocoon. Rowan County, Kentucky.

Plate X

Genitalia

- Fig. 58.—*Bucculatrix fusicola* Braun, male genitalia, ventral view; 58a, aedeagus; 58b, tip of aedeagus greatly enlarged. Cincinnati, Ohio.
- Fig. 59.—*Bucculatrix fusicola* Braun, female genitalia, ventral view; 59a, two ventral ribs of signum highly magnified. Cincinnati, Ohio.
- Fig. 60.—*Bucculatrix montana* Braun, type, male genitalia, ventral view; 60a, apex of harpe, greatly enlarged. Mountain Lake, Virginia.
- Fig. 61.—*Bucculatrix montana* Braun, female genitalia, ventral view (bursa copulatrix omitted), signum as in *solidaginiella*. Adams County, Ohio.
- Fig. 62.—*Bucculatrix solidaginiella* new species, paratype, male genitalia, ventral view; 62a, conical setae of apex of harpe, greatly enlarged. Cincinnati, Ohio.

- Fig. 63.—*Bucculatrix solidaginiella* new species, paratype, female genitalia, ventral view; 63a, two ventral ribs of signum highly magnified, Cincinnati, Ohio; 63b, two ventral ribs of signum highly magnified, Bonneville, Washington.

Plate XI

Genitalia

- Fig. 64.—*Bucculatrix magnella* Chambers, paratype (slide by A. Busck), lateral view of male genitalia, left harpe omitted; 64a, conical setae of apex of harpe, much enlarged. Texas.
- Fig. 65.—*Bucculatrix magnella* Chambers, female genitalia, ventral view; 65a, one ventral rib of signum highly magnified. Chicago, Illinois.
- Fig. 66.—*Bucculatrix needhami* Braun, type, male genitalia (anellus and aedeagus omitted), ventral view; 66a, aedeagus. Englewood, Florida.
- Fig. 67.—*Bucculatrix needhami* Braun, allotype, female genitalia, ventral view (bursa copulatrix omitted); 67a, several ribs of signum highly magnified. Englewood, Florida.
- Fig. 68.—*Bucculatrix longula* new species, paratype, male genitalia, ventral view; 68a, tip of aedeagus, much enlarged. Wilma, Whitcom County, Washington.
- Fig. 69.—*Bucculatrix longula* new species, paratype, female genitalia, ventral view (bursa copulatrix omitted); 69a, several ribs of signum highly magnified. Wilma, Whitcom County, Washington.

Plate XII

Genitalia

- Fig. 70.—*Bucculatrix simulans* new species, paratype, aedeagus; 70a, tip of aedeagus much enlarged. Austin, Texas. 70b, tip of aedeagus much enlarged. East St. Louis, Illinois. 70c, tip of aedeagus much enlarged (from specimen of the Colorado series).
- Fig. 71.—*Bucculatrix simulans* new species, paratype, female genitalia, ventral view; 71a, one ventral rib of signum highly magnified. Austin, Texas.
- Fig. 72.—*Bucculatrix parvinotata* new species, type, male genitalia, ventral view (anellus omitted). Mesilla Park, New Mexico.
- Fig. 73.—*Bucculatrix ochritincta* new species, type, female genitalia, ventral view (bursa copulatrix omitted); 73a, one ventral rib of signum; 73b, dorsal ribs of signum highly magnified. Fall Creek Falls State Park, Tennessee.
- Fig. 74.—*Bucculatrix viguierae* new species, allotype, female genitalia, ventral view (bursa copulatrix omitted); 74a, several ribs of signum highly magnified. Sierra County, New Mexico.

- Fig. 75.—*Bucculatrix viguierae* new species, type, male genitalia, ventral view (anellus omitted). Sierra County, New Mexico.

Plate XIII

Genitalia

- Fig. 76.—*Bucculatrix inusitata* new species, paratype; 76a, male genitalia, ventral view, right harpe detached; 76b, inner face of right harpe; 76c, subscaphium and free arms of gnathos, much enlarged. Barnstable, Massachusetts.
- Fig. 77.—*Bucculatrix inusitata* new species, paratype, female genitalia, ventral view; 77a, one ventral rib of signum highly magnified. Augusta, Maine.
- Fig. 78.—*Bucculatrix bicristata* new species, type, male genitalia, ventral view. St. Petersburg, Florida.
- Fig. 79.—*Bucculatrix micropunctata* new species, type, male genitalia, ventral view; 79a, aedeagus; 79b, tip of aedeagus, much enlarged. Needles, California.
- Fig. 80.—*Bucculatrix seneciensis* new species, paratype, male genitalia, ventral view (aedeagus omitted); 80a, aedeagus; 80b, scale sac. Lovejoy Buttes, Los Angeles County, California.
- Fig. 81.—*Bucculatrix seneciensis* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 81a, signum; 81b, one ventral rib of signum highly magnified. Mint Canyon, Los Angeles County, California.

Plate XIV

Genitalia

- Fig. 82.—*Bucculatrix cuneigera* Meyrick, male genitalia, ventral view; 82a, scale sac everted, scales expanded. Cincinnati, Ohio.
- Fig. 83.—*Bucculatrix cuneigera* Meyrick, female genitalia, ventral view. Cincinnati, Ohio.
- Fig. 84.—*Bucculatrix ochristrigella* Braun, paratype, female genitalia (bursa copulatrix omitted), ventral view. Mills College, Alameda County, California.
- Fig. 85.—*Bucculatrix ochristrigella* Braun, paratype, male genitalia, ventral view; 85a, aedeagus. Mills College, Alameda County, California.
- Fig. 86.—*Bucculatrix albaciliella* Braun, paratype, male genitalia, ventral view. Mills College, Alameda County, California.
- Fig. 87.—*Bucculatrix albaciliella* Braun, paratype, female genitalia (bursa copulatrix omitted), ventral view; 87a, one ventral rib of signum highly magnified. Alameda County, California.

Plate XV

Genitalia

- Fig. 88.—*Bucculatrix eurotiella* Walsingham, male genitalia, ventral view; 88a, right harpe (detached); 88b, aedeagus; 88c, scale sac. Cache County, Utah.
- Fig. 89.—*Bucculatrix eurotiella* Walsingham, female genitalia, ventral view; 89a, two ribs of signum highly magnified. From slide of specimen from Cache County, Utah, agreeing with slide of type (J. F. G. Clarke, 10415).
- Fig. 90.—*Bucculatrix eurotiella* Walsingham, type, female, left lateral lobe of segment 7 overlying basal part of segment 8, showing marginal scales of lobe of segment 7, and the tuft of specialized scales beneath it on the intersegmental membrane. (Slide 10415, J. F. G. Clarke). Lancaster, Los Angeles County, California.
- Fig. 91.—*Bucculatrix tenebricosa* Braun, paratype, female genitalia (bursa copulatrix omitted), ventral view. Logan, Cache County, Utah.
- Fig. 92.—*Bucculatrix tenebricosa* Braun, paratype, male genitalia, ventral view. Logan, Cache County, Utah.
- Fig. 93.—*Bucculatrix ericameriae* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 93a, specialized setae of lobes of segment 8, one highly magnified; 93b, several ribs of signum, highly magnified. Placerville, California.

Plate XVI

Genitalia

- Fig. 94.—*Bucculatrix variabilis* Braun, male genitalia, ventral view; 94a, aedeagus. Stanford, California.
- Fig. 95.—*Bucculatrix variabilis* Braun, female genitalia (bursa copulatrix omitted), ventral view; 95a, lateral plate of segment 7, more highly magnified. San Francisco, California.
- Fig. 96.—*Bucculatrix separabilis* new species, allotype, male genitalia, ventral view; 96a, aedeagus. Stanford, Santa Clara County, California.
- Fig. 97.—*Bucculatrix separabilis* new species, type, female genitalia (bursa copulatrix omitted), ventral view; 97a, lateral lobe of segment 7, more highly magnified. Stanford, Santa Clara County, California.
- Fig. 98.—*Bucculatrix evanescens* new species, type, male genitalia, ventral view; 98a, aedeagus. Olancha, Inyo County, California.
- Fig. 99.—*Bucculatrix brunnescens* new species, type, male genitalia, ventral view; 99a, aedeagus; 99b, scale sac. Elk Point, South Dakota.

Plate XVII

Genitalia

- Fig. 100.—*Bucculatrix floccosa* Braun, paratype, male genitalia, ventral view; 100a, cucullus of harpe highly magnified; 100b, aedeagus. Olancha, Inyo County, California.
- Fig. 101.—*Bucculatrix floccosa* Braun, paratype, female genitalia, ventral view; 101a, specialized scales of segment 8 highly magnified; 101b, several ribs of signum highly magnified. Olancha, Inyo County, California.
- Fig. 102.—*Bucculatrix benenotata* new species, type, female genitalia (to the same scale as fig. 104, *evanescens*) (bursa copulatrix omitted). Pena Blanca Canyon, Santa Cruz County, Arizona.
- Fig. 103.—*Bucculatrix evanescens* new species, paratype, female genitalia (bursa copulatrix omitted, specialized scales of segment 8 removed), ventral view; 103a, several ribs of signum highly magnified. Superior, Arizona.
- Fig. 104.—*Bucculatrix evanescens* new species, allotype, ostium and sternite of segment 8, much enlarged, to show the specialized scaling. Olancha, Inyo County, California.

Plate XVIII

Genitalia

- Fig. 105.—*Bucculatrix flourensiae* new species, paratype, male genitalia, ventral view; 105a, aedeagus; 105b, left harpe of allotype. Pearce, Arizona.
- Fig. 106.—*Bucculatrix flourensiae* new species, type, female genitalia, ventral view; *v*, ventral rib of signum, *d*, mid-dorsal rib, highly magnified. Pearce, Arizona.
- Fig. 107.—*Bucculatrix flourensiae* new species, paratype, dorsal view of eighth abdominal segment of female. Pearce, Arizona.
- Fig. 108.—*Bucculatrix franseriae* new species, paratype, male genitalia, ventral view. Tempe, Arizona.
- Fig. 109.—*Bucculatrix franseriae* new species, allotype, female genitalia, ventral view. Tempe, Arizona.

Plate XIX

Genitalia

- Fig. 110.—*Bucculatrix staintonella* Chambers, male genitalia, ventral view; 110a, portion of apex of harpe more highly magnified; 110b, aedeagus; 110c, scale sac. Winnfield, Louisiana.
- Fig. 111.—*Bucculatrix staintonella* Chambers, female genitalia, ventral view; Winnfield, Louisiana.

- Fig. 112.—*Bucculatrix agnella* Clemens, female genitalia, ventral view; 112a, one ventral rib of signum highly magnified; 112b, vaginal setae highly magnified. Cincinnati, Ohio.
- Fig. 113.—*Bucculatrix agnella* Clemens, male genitalia, harpes omitted; 113a, right harpe; 113b, lateral view of tegumen, socii and subscaphium; 113c, aedeagus; 113d, scale sac (same magnification as genitalia). Cincinnati, Ohio and Mineral Springs, Adams County, Ohio.

Plate XX

Genitalia

- Fig. 114.—*Bucculatrix kimballi* new species, type, male genitalia, lateral view (harpes omitted); 114a, right harpe; 114b, aedeagus. Oneco, Manatee County, Florida.
- Fig. 115.—*Bucculatrix kimballi* new species, paratype, female genitalia, ventral view; 115a, a portion of signum highly magnified. Oneco, Manatee County, Florida.
- Fig. 116.—*Bucculatrix ivella* Busck, cotype, male genitalia, ventral view. Palm Beach, Florida.
- Fig. 117.—*Bucculatrix ivella* Busck, female genitalia (bursa copulatrix omitted), ventral view; 117a, several ribs of signum highly magnified. (Slide compared with slide of a cotype). "N. Riv. Hwy 50," Maryland.

Plate XXI

Genitalia

- Fig. 118.—*Bucculatrix ambrosiaefoliella* Chambers, male genitalia, ventral view. Cincinnati, Ohio.
- Fig. 119.—*Bucculatrix ambrosiaefoliella* Chambers, female genitalia (bursa copulatrix omitted), ventral view; 119a, one ventral rib of signum highly magnified. Cincinnati, Ohio.
- Fig. 120.—*Bucculatrix pallidula* new species, type, female genitalia, ventral view; 120a, a section of signum highly magnified. Zion Canyon, Utah.
- Fig. 121.—*Bucculatrix taeniola* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view; 121a, one of the groups of spined ribs of signum, highly magnified. Mt. Wilson, California.
- Fig. 122.—*Bucculatrix taeniola* new species, type, male genitalia, ventral view; 122a, aedeagus; 122b, scale sac (slide by Busck). Salinas, California.

Plate XXII

Genitalia

- Fig. 123.—*Bucculatrix carolinac* new species, type, female genitalia, ventral view; 123a, one ventral rib of signum highly magnified; 123b, tergite of basal half of segment 8. Cherry Hill Recreation Area, Oconee County, South Carolina.
- Fig. 124.—*Bucculatrix adelpha* new species, allotype, female genitalia, ventral view; 124a, one signum rib highly magnified. Ottawa, Ontario.
- Fig. 125.—*Bucculatrix angustata* Frey and Boll, female genitalia, ventral view. Cincinnati, Ohio.
- Fig. 126.—*Bucculatrix angustata* Frey and Boll, male genitalia, ventral view; 126a, inner surface of right harpe; 126b, aedeagus. Cincinnati, Ohio.
- Fig. 127.—*Bucculatrix adelpha* new species, type, male genitalia (left harpe detached), ventral view; 127a, inner surface of left harpe; 127b, aedeagus. East Ottawa, Ontario.

Plate XXIII

Genitalia

- Fig. 128.—*Bucculatrix pluchae* new species, type, male genitalia, ventral view; 128a, inner surface of harpe, to show concave margin of costa below apex. Key West, Florida.
- Fig. 129.—*Bucculatrix pluchae* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view; 129a, two ventral ribs of signum, with minute spines between, highly magnified. Key West, Florida.
- Fig. 130.—*Bucculatrix eupatoriella* Braun, paratype, male genitalia, ventral view. Cincinnati, Ohio.
- Fig. 131.—*Bucculatrix eupatoriella* Braun, paratype, female genitalia (bursa copulatrix omitted), ventral view; 131a, one ventral rib of signum highly magnified. Cincinnati, Ohio.
- Fig. 132.—*Bucculatrix polynniae* new species, paratype, male genitalia, ventral view; 132a, aedeagus. Rowan County, Kentucky.
- Fig. 133.—*Bucculatrix polynniae*, new species, paratype, female genitalia, ventral view; 133a, two ventral ribs of signum highly magnified. Rowan County, Kentucky.

Plate XXIV

Genitalia

- Fig. 134.—*Bucculatrix sexnotata* Braun, male genitalia, ventral view. Ash Cave, Hocking County, Ohio.
- Fig. 135.—*Bucculatrix sexnotata* Braun, female genitalia (bursa copulatrix omitted), ventral view; 135a, two ribs of signum highly magnified. Ash Cave, Hocking County, Ohio.
- Fig. 136.—*Bucculatrix speciosa* new species, type, female genitalia (bursa copulatrix omitted), ventral view; 136a, one ventral rib of signum highly magnified. Cranberry Glades, Pocahontas County, West Virginia.
- Fig. 137.—*Bucculatrix subnitens* Walsingham, female genitalia (bursa copulatrix omitted), ventral view, specialized scales of left scale pocket lost; 137a, one ventral rib of signum highly magnified. Madera Canyon, Santa Rita Mountains, Arizona.

Plate XXV

Genitalia

- Fig. 138.—*Bucculatrix divisa* Braun, paratype, male genitalia, ventral view. Cache County, Utah.
- Fig. 139.—*Bucculatrix divisa* Braun, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left; 139a, one ventral rib of signum highly magnified. Clarkston, Washington.
- Fig. 140.—*Bucculatrix illecebrosa* new species, paratype, male genitalia, ventral view; 140a, aedeagus. Colfax, Placer County, California.
- Fig. 141.—*Bucculatrix illecebrosa* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left. Colfax, Placer County, California.
- Fig. 142.—*Bucculatrix transversata* Braun, type, male genitalia, ventral view; 142a, aedeagus. Rivera, Los Angeles County, California.

Plate XXVI

Genitalia

- Fig. 143.—*Bucculatrix insolita* Braun, type, male genitalia, ventral view; 143a, aedeagus, with tip highly magnified. Camp Baldy, San Bernardino Mountains, California.
- Fig. 144.—*Bucculatrix insolita* Braun, allotype, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left; 144a, two ventral ribs of signum highly magnified. Fredalba, San Bernardino Mountains, California.

- Fig. 145.—*Bucculatrix koebelcella* Busck, ex type series, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left. Los Angeles County, California.
- Fig. 146.—*Bucculatrix koebelcella* Busck, male genitalia, ventral view. Los Angeles County, California.
- Fig. 147.—*Bucculatrix leptalca* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view; 147a, two ventral ribs of signum highly magnified. Snake River, opposite Clarkston, Washington.
- Fig. 148.—*Bucculatrix leptalca* new species, type, male genitalia, ventral view; 148a, tip of socius, more highly magnified; 148b, aedeagus; 148c, scale sac. Snake River, opposite Clarkston, Washington.

Plate XXVII

Genitalia

- Fig. 149.—*Bucculatrix saluatoria* Braun, paratype, male genitalia, ventral view. Rich County, Utah.
- Fig. 150.—*Bucculatrix saluatoria* Braun, female genitalia (bursa copulatrix omitted), ventral view. Hedley, British Columbia. 150a, paratype, two ribs of signum highly magnified. Rich County, Utah.
- Fig. 151.—*Bucculatrix saluatoria* Braun, paratype, 9th abdominal segment of female, showing exerted vagina and highly magnified vaginal setae. Rich County, Utah.
- Fig. 152.—*Bucculatrix arnicella* Braun, paratype, male genitalia, ventral view. Logan Canyon, near Logan, Utah.
- Fig. 153.—*Bucculatrix arnicella* Braun, type, female genitalia (bursa copulatrix omitted), ventral view. Logan Canyon, near Logan, Utah.

Plate XXVIII

Genitalia

- Fig. 154.—*Bucculatrix tridenticola* new species, type, male genitalia, ventral view; 154a, aedeagus (Slide 10505, J. F. G. Clarke). Spring Creek, Baker County, Oregon.
- Fig. 155.—*Bucculatrix tridenticola* new species, paratype, a different view of tegumen and socii. Entiat, Washington.
- Fig. 156.—*Bucculatrix tridenticola* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left; 156a, one ventral rib of signum highly magnified. Ephraim, Utah.
- Fig. 157.—*Bucculatrix spectabilis* new species, type, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left. Madera Canyon, Santa Rita Mountains, Arizona.

Fig. 158.—*Bucculatrix seorsa* new species, type, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left. Wendel, Lassen County, California.

Fig. 159.—*Bucculatrix seorsa* new species, allotype, male genitalia (anellus omitted), ventral view; 159a, aedeagus. Wendel, Lassen County, California.

Plate XXIX

Genitalia

Fig. 160.—*Bucculatrix angustisquamella* Braun, paratype, female genitalia (bursa copulatrix omitted), ventral view; highly magnified vaginal setae to the left; 160a, a small area of reticulate surface of segment 8 highly magnified. Logan Canyon, Utah.

Fig. 161.—*Bucculatrix angustisquamella* Braun, paratype, male genitalia, ventral view; 161a, scale sac. Logan Canyon, Utah.

Fig. 162.—*Bucculatrix columbiana* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view; 162a, three ventral ribs of signum highly magnified. Kelowna, British Columbia.

Fig. 163.—*Bucculatrix columbiana* new species, type, male genitalia, ventral view; 163a, aedeagus. Kelowna, British Columbia.

Plate XXX

Genitalia

Fig. 164.—*Bucculatrix sororcula* new species, type, male genitalia, ventral view; 164a, aedeagus. Boyce Thompson Arboretum, Superior, Arizona.

Fig. 165.—*Bucculatrix sororcula* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view; 165a, one ventral rib of signum highly magnified. Olancho, Inyo County, California.

Fig. 166.—*Bucculatrix nigripunctella* Braun, paratype, female genitalia (bursa copulatrix omitted), ventral view. Palm Springs, California.

Fig. 167.—*Bucculatrix atosignata* new species, type, female genitalia (bursa copulatrix omitted), ventral view; 167a, two ventral ribs of signum highly magnified. Eureka, Utah.

Plate XXXI

Genitalia

Fig. 168.—*Bucculatrix atosignata* new species, allotype, male genitalia, ventral view; 168a, aedeagus; 168b, scale sac. Eureka, Utah.

Fig. 169.—*Bucculatrix latella* Braun, paratype, male genitalia, ventral view. Loma Linda, California.

Fig. 170.—*Bucculatrix latella* Braun, female genitalia (bursa copulatrix omitted), ventral view, vagina exerted; vaginal setae to left, highly magnified; 170a, two ribs of signum highly magnified. Monache Meadows, Tulare County, California.

- Fig. 171.—*Bucculatrix latella* Braun, type, ninth abdominal segment of female, showing vagina within the body and its anterior margin, which is the line of junction with the oviduct. Loma Linda, California.

Plate XXXII

Genitalia

- Fig. 172.—*Bucculatrix enceliae* new species, paratype, male genitalia, ventral view; 172a, aedeagus, with tip enlarged. Palm Springs, California.
- Fig. 173.—*Bucculatrix enceliae* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; portion of vagina enlarged (to left) and vaginal setae highly magnified (to right); 173a, one ventral rib of signum highly magnified. From slide 560 (A. F. B.), San Diego, California; some details from slide 484 (A. F. B.), Palm Springs, California, and from slide 548 (A. F. B.), White-water, California.
- Fig. 174.—*Bucculatrix sporobolella* Busck, male genitalia, ventral view; 174a, aedeagus; 174b, several clusters of scales of the scale sac. Loma Linda, California.
- Fig. 175.—*Bucculatrix sporobolella* Busck, type, female genitalia (bursa copulatrix omitted), ventral view; 175a, one ventral rib of signum highly magnified (Slide 10414, J. F. G. Clarke). Cimarron, New Mexico.

Plate XXXIII

Genitalia

- Fig. 176.—*Bucculatrix canadensisella* Chambers, lateral aspect of denuded tip of female abdomen showing position of fringes and tufts or patches of specialized scales (refer to text p. 148 for further explanation of this figure).
- Fig. 177.—*Bucculatrix eugrapha* new species, type, scale sac, dorsal view, as seen retracted into the body. For expanded scales, see fig. 82a.
- Fig. 178.—*Bucculatrix packardella* Chambers, female genitalia, ventral view; 178a, one ventral rib of signum highly magnified. Cincinnati, Ohio.
- Fig. 179.—*Bucculatrix packardella* Chambers, male genitalia, ventral view; 179a, lateral view, right harpe removed; 179b, scale sac. Cincinnati, Ohio.

Plate XXXIV

Genitalia

- Fig. 180.—*Bucculatrix albertiella* Busck, cotype, female genitalia, ventral view; 180a, dentate strip of ductus bursae; 180b, one ventral rib of signum highly magnified. Alameda County, California.
- Fig. 181.—*Bucculatrix albertiella* Busck, male genitalia (left harpe omitted), ventral view. Alameda County, California.
- Fig. 182.—*Bucculatrix ochrisuffusa* new species, type, female genitalia (bursa copulatrix omitted), ventral view; 182a, a series of ribs of signum highly magnified. Cincinnati, Ohio.
- Fig. 183.—*Bucculatrix platyphylla* new species, type, female genitalia. E. Aurora, New York.

Plate XXXV

Genitalia

- Fig. 184.—*Bucculatrix coniforma* new species, type, female genitalia (bursa copulatrix omitted), ventral view; 184a, a modified scale of the dorsal anterior margin of segment 8, highly magnified; 184b, one ventral rib of signum highly magnified. Martha's Vineyard, Massachusetts.
- Fig. 185.—*Bucculatrix trifasciella* Clemens, female genitalia (bursa copulatrix omitted), ventral view; 185a, one ventral rib of signum highly magnified. Cincinnati, Ohio.
- Fig. 186.—*Bucculatrix trifasciella* Clemens, male genitalia, ventral view; 186a, lateral view (right harpe removed). Cincinnati, Ohio.
- Fig. 187.—*Bucculatrix quinquenotella* Chambers, female genitalia (bursa copulatrix omitted), ventral view. Iowa City, Iowa.
- Fig. 188.—*Bucculatrix quinquenotella* Chambers, male genitalia, ventral view. Iowa City, Iowa.
- Fig. 189.—Dorsal view (inner surface) of harpe, showing the articulation with anellus characteristic of Section IV; concave membranous basal portion of harpe (lightly stippled) lies in contact with the convex surface of the anellus. Note also the small costal process which engages the slender vinculum. *Bucculatrix quinquenotella* Chambers. Highlands, North Carolina.

Plate XXXVI

Genitalia

- Fig. 190.—*Bucculatrix domicola* new species, paratype, male genitalia, most of right harpe removed, semi-lateral view. Cincinnati, Ohio.

- Fig. 191.—*Bucculatrix domicola* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 191a, one ventral rib of signum highly magnified. Cincinnati, Ohio.
- Fig. 192.—*Bucculatrix zophopasta* new species, type, male genitalia, ventral view. Hood River, Oregon.
- Fig. 193.—*Bucculatrix zophopasta* new species, paratype, male genitalia, lateral view (right harpe removed). Victoria, British Columbia.
- Fig. 194.—*Bucculatrix zophopasta* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 194a, one ventral rib of signum highly magnified. Victoria, British Columbia.
- Fig. 195.—*Bucculatrix litigiosella* Zeller, type, female genitalia, ventral view; 195a, one ventral rib of signum highly magnified (Slide No. 10655, J. F. G. Clarke). Dallas, Texas.

Plate XXXVII

Genitalia

- Fig. 196.—*Bucculatrix coronatella* Clemens, female genitalia (bursa copulatrix omitted), ventral view; 196a, one ventral rib of signum highly magnified. Washington, D. C.
- Fig. 197.—*Bucculatrix coronatella* Clemens, male genitalia, ventral view. Washington, D. C.
- Fig. 198.—*Bucculatrix canadensisella* Chambers, male genitalia, ventral view. Douglas Lake, Michigan.
- Fig. 199.—*Bucculatrix canadensisella* Chambers, female genitalia (bursa copulatrix omitted), ventral view; 199a, one ventral rib of signum highly magnified. Merivale, Ontario.
- Fig. 200.—*Bucculatrix improvisa* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 200a, two ventral ribs of signum highly magnified. Ft. Ancient State Memorial, Warren County, Ohio.
- Fig. 201.—*Bucculatrix improvisa* new species, paratype, male genitalia, ventral view. Ft. Ancient State Memorial, Warren County, Ohio.

Plate XXXVIII

Genitalia

- Fig. 202.—*Bucculatrix polytita* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view; 202a, ventral ribs of signum highly magnified. Bobcaygeon, Ontario.
- Fig. 203.—*Bucculatrix polytita* new species, type, male genitalia, ventral view. Bobcaygeon, Ontario.
- Fig. 204.—*Bucculatrix recognita* new species, paratype, male genitalia, ventral view. Cohasset, Massachusetts. 204a, ventral view of aedeagus, paratype. Washington, D. C.

Fig. 205.—*Bucculatrix recognita* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 205a, a section of the signum highly magnified. Kirkwood, Missouri.

Fig. 206.—*Bucculatrix recognita* new species, allotype, ostium and associated structures. Ottawa, Ontario.

Plate XXXIX

Genitalia

Fig. 207.—*Bucculatrix luteella* Chambers, male genitalia, ventral view; 207a, lateral view of aedeagus and anellus; 207b, scale sac. Cincinnati, Ohio.

Fig. 208.—*Bucculatrix luteella* Chambers, female genitalia (bursa copulatrix omitted), ventral view; 208a, two ventral ribs of signum highly magnified. Cincinnati, Ohio.

Fig. 209.—*Bucculatrix paroetila* new species, paratype, male genitalia, ventral view. Augusta, Maine.

Fig. 210.—*Bucculatrix paroetila* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view. Augusta, Maine.

Fig. 211.—*Bucculatrix fugitans* Braun, type, male genitalia (right harpe removed), ventral view; 211a, scale sac. Adams County, Ohio.

Fig. 212.—*Bucculatrix fugitans* Braun, female genitalia (bursa copulatrix omitted), ventral view. Scioto County, Ohio.

Fig. 213.—*Bucculatrix callistricha* new species, paratype, female genitalia (bursa copulatrix omitted), ventral view; 213a, one ventral rib of signum highly magnified. Beaver Pond, Adams County, Ohio.

Fig. 214.—*Bucculatrix callistricha* new species, paratype, male genitalia, ventral view; 214a, scale sac (to same scale as fig. 211a). Beaver Pond, Adams County, Ohio.

Plate XL

Genitalia

Fig. 215.—*Bucculatrix eugrapha* new species, type, male genitalia, ventral view. Tweed, Ontario.

Fig. 216.—*Bucculatrix cerina* new species, type, male genitalia, ventral view; 216a, aedeagus; 216b, scale sac. Siesta Key, Sarasota County, Florida.

Fig. 217.—*Bucculatrix copeuta* Meyrick, male genitalia, ventral view; 217a, aedeagus. Sparrow Lake, Ontario.

Fig. 218.—*Bucculatrix copeuta* Meyrick, female genitalia (bursa copulatrix omitted), ventral view; 218a, two ventral ribs of signum highly magnified. Sparrow Lake, Ontario.

Fig. 219.—*Bucculatrix locuples* Meyrick, male genitalia, ventral view. Fleming County, Kentucky.

- Fig. 220.—*Bucculatrix locuples* Meyrick, female genitalia (bursa copulatrix omitted), ventral view; 220a, one ventral rib of signum highly magnified. Rowan County, Kentucky.

Plate XLI

Genitalia

- Fig. 221.—*Bucculatrix ainsliella* Murtfeldt, female genitalia, ventral view. Essex County Park, New Jersey.
- Fig. 222.—*Bucculatrix ainsliella* Murtfeldt, male genitalia, ventral view. Labeled "topotype" but probably from Rochester, New York. Fig. 222a, harpe from inner side; 222b, cornuti. Monroe County, New York.
- Fig. 223.—*Bucculatrix eclecta* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view. Albany (?), New York.
- Fig. 224.—*Bucculatrix eclecta* new species, paratype, male genitalia, ventral view; 224a, aedeagus and anellus. Augusta, Maine.

Plate XLII

Genitalia

- Fig. 225.—*Bucculatrix anaticula* new species, paratype, male genitalia, ventral view; 225a, aedeagus. Constance Bay, Ontario.
- Fig. 226.—*Bucculatrix anaticula* new species, paratype, female genitalia, ventral view. Constance Bay, Ontario.
- Fig. 227.—*Bucculatrix disjuncta* new species, type, male genitalia, ventral view; 227a, aedeagus. Denver, Colorado.
- Fig. 228.—*Bucculatrix pomifoliella* Clemens, male genitalia; 228a, ventral aspect; 228b, dorsal aspect of vinculum, tegumen and socii; 228c, aedeagus. Cincinnati, Ohio.
- Fig. 229.—*Bucculatrix pomifoliella* Clemens, female genitalia, ventral view; 229a, one rib of signum highly magnified. Cincinnati, Ohio.
- Fig. 230.—*Bucculatrix ceanothiella* Braun, type, female genitalia, ventral view. Colton, San Bernardino County, California.

Plate XLIII

Genitalia

- Fig. 231.—*Bucculatrix ilecella* Busck, female genitalia, ventral view. Brownsville, Texas.
- Fig. 232.—*Bucculatrix ilecella* Busck, male genitalia (ventral lobe of right harpe removed), ventral view; 232a, aedeagus. Brownsville, Texas.

- Fig. 233.—*Bucculatrix gossypiella* Morrill, paratype, male genitalia, ventral view (slide by A. Busck, "type material, photo subjects"); 233a, right harpe, flattened inner surface (Slide No. 9944, J. F. G. Clarke); 233b, aedeagus. Cajeme, Sonora, Mexico.
- Fig. 234.—*Bucculatrix gossypiella* Morrill, paratype, female genitalia, ventral view (Slide No. 9945, J. F. G. Clarke); 234a, a portion of the signum highly magnified. Cajeme, Sonora, Mexico.

Plate XLIV

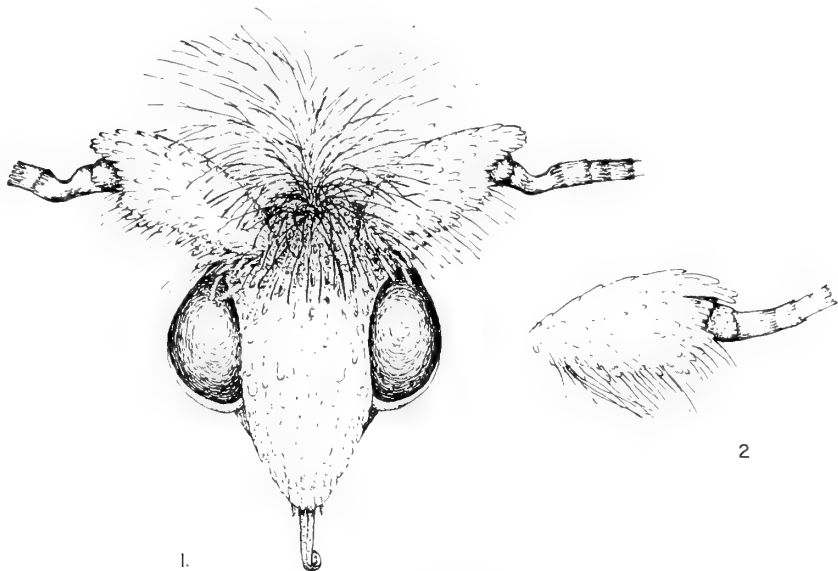
Genitalia

- Fig. 235.—*Bucculatrix quadrigemina* Braun, paratype, male genitalia, ventral view; 235a, sclerotized plate of sternite of segment 8. Loma Linda, San Bernardino County, California.
- Fig. 236.—*Bucculatrix quadrigemina* Braun, female genitalia (bursa copulatrix omitted), ventral view; 236a, dorsal aspect of sclerotized basal half of segment 8; 236b, one ventral rib of signum highly magnified. San Diego, California.
- Fig. 237.—*Bucculatrix sphaeralceae* new species, paratype, male genitalia, ventral view; 237a, arms of gnathos, enlarged; 237b, aedeagus; 237c, ventral plate of eighth abdominal segment. Blythe, California.
- Fig. 238.—*Bucculatrix sphaeralceae* new species, allotype, female genitalia (bursa copulatrix omitted), ventral view. Presidio, Texas. 238a, a representative section of signum highly magnified. Blythe, California.

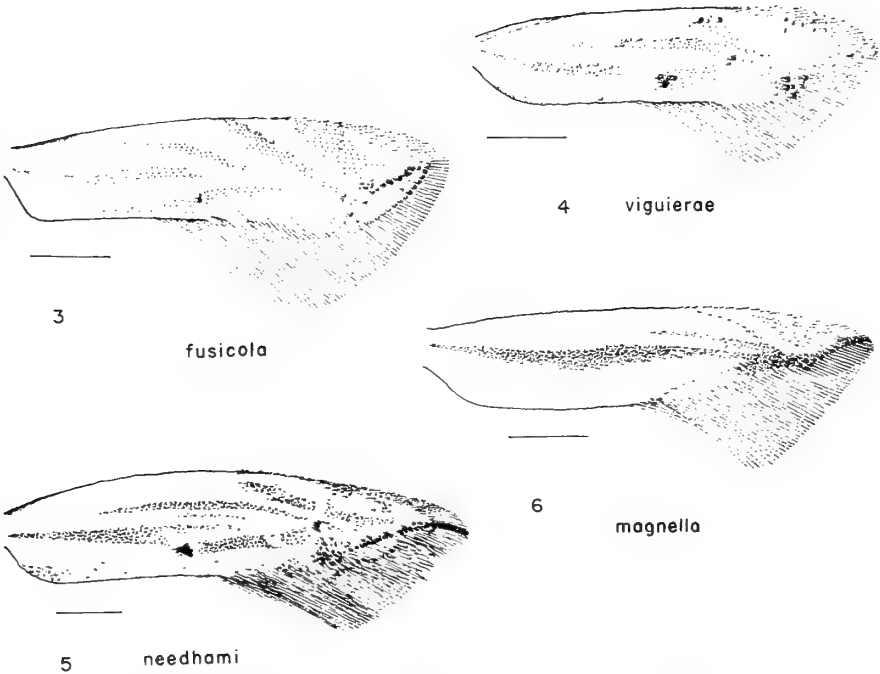
Plate XLV

Genitalia

- Fig. 239.—*Bucculatrix thurberiella* Busck, paratype, male genitalia, ventral view (slide by A. Busck); 239a, inner surface of right harpe, flattened out; 239b, aedeagus; 239c, ventral plate of segment 8; 239d, dorsal plate of segment 8; 239e, scale sac. (All figures to the same scale.) From type material from Santa Catalina Mountains, Arizona, and material on cotton from Mesa and Tucson, Arizona.
- Fig. 240.—*Bucculatrix thurberiella* Busck, paratype, female genitalia (bursa copulatrix omitted), ventral view (slide by A. Busck); 240a, setae on sclerotized area of membrane of segment 8; 240b, a small area of signum highly magnified. Santa Catalina Mountains, Arizona.



solidaginiella



fusicola

viguierae

magnella

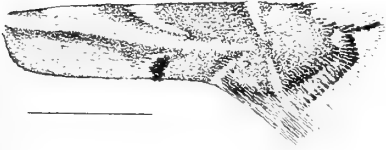
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7 sphaeralceae



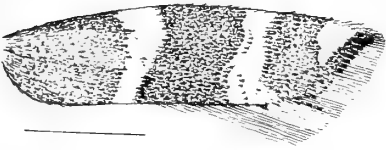
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10 illecebrosa



11 taeniola



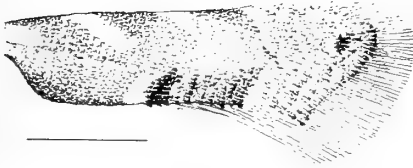
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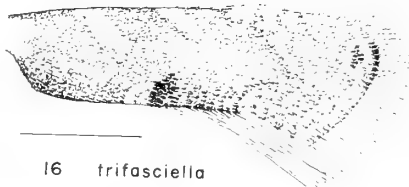
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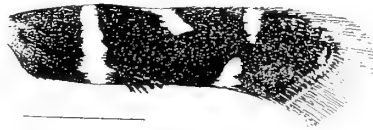
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16 trifasciella



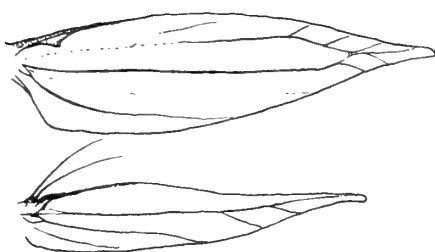
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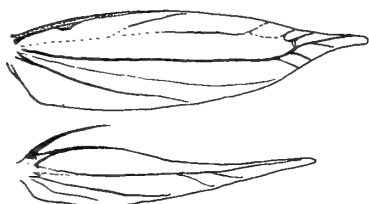
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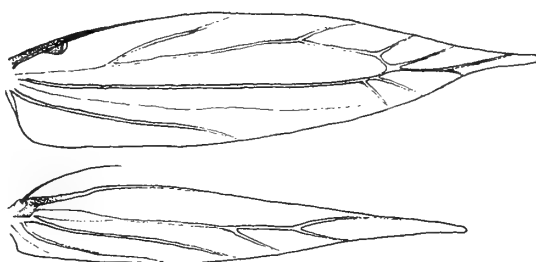
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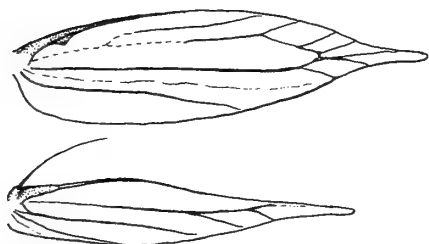
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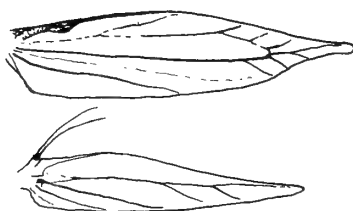
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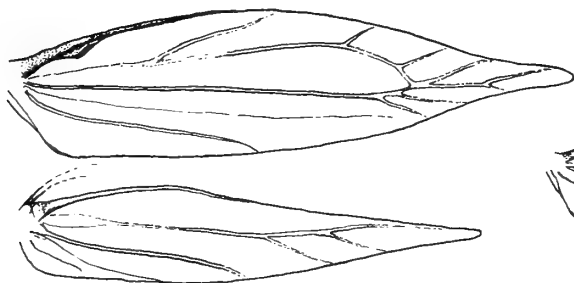
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23 thurberiella



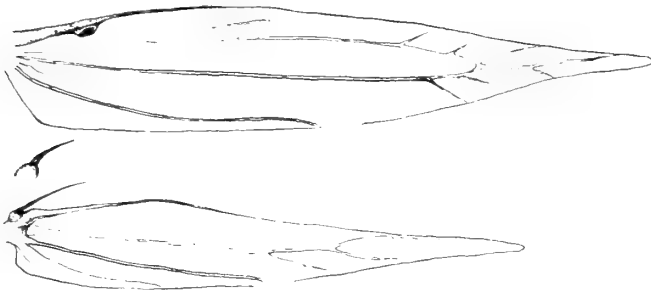
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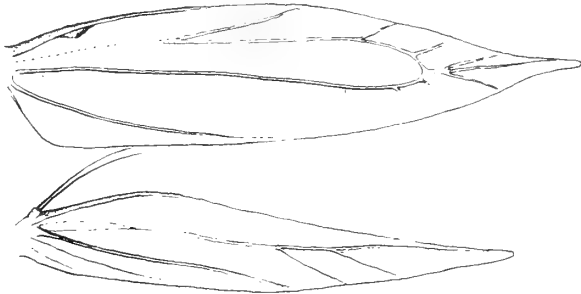
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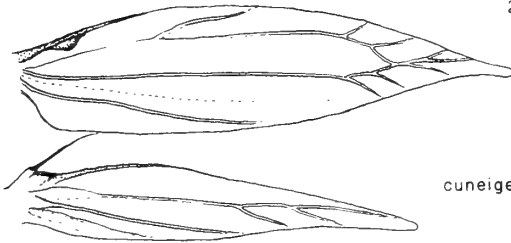
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27 *ochristrigella*

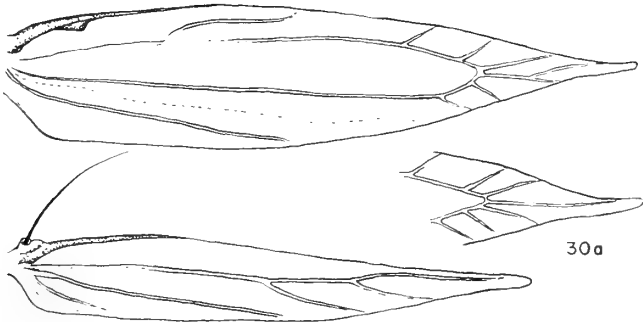


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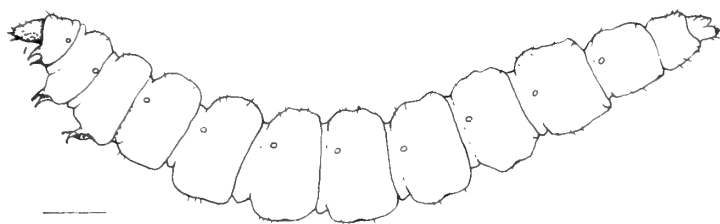
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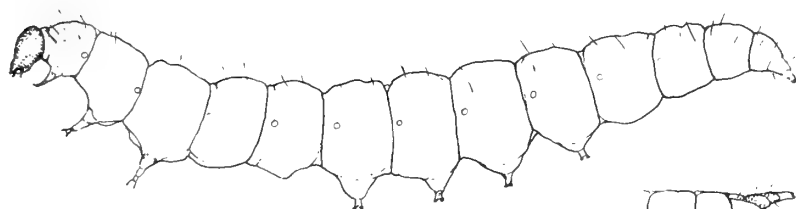


30a

30 *solidaginiella*



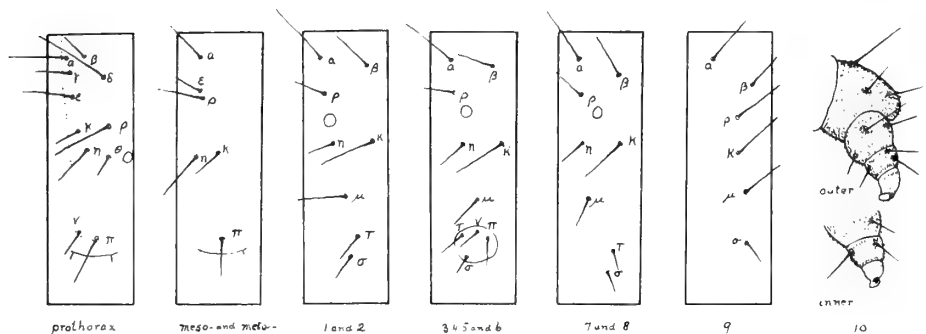
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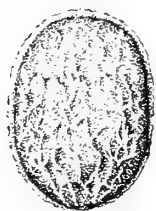
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33 callistricha



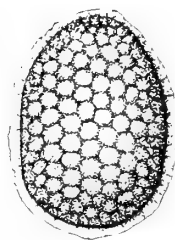
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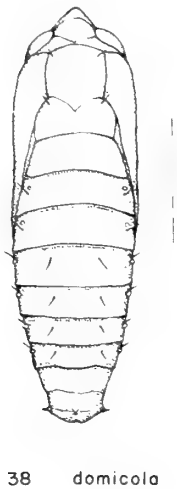


36 polymniae



37 callistricha

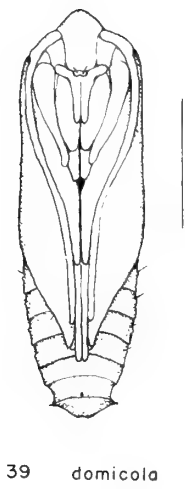
BRAUN-BUCCULATRIX IN NORTH AMERICA



38 domicola



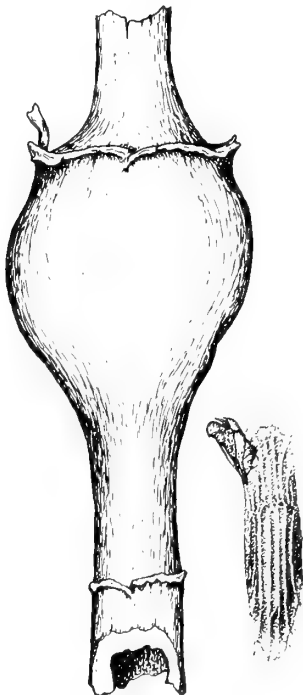
40 domicola



39 domicola

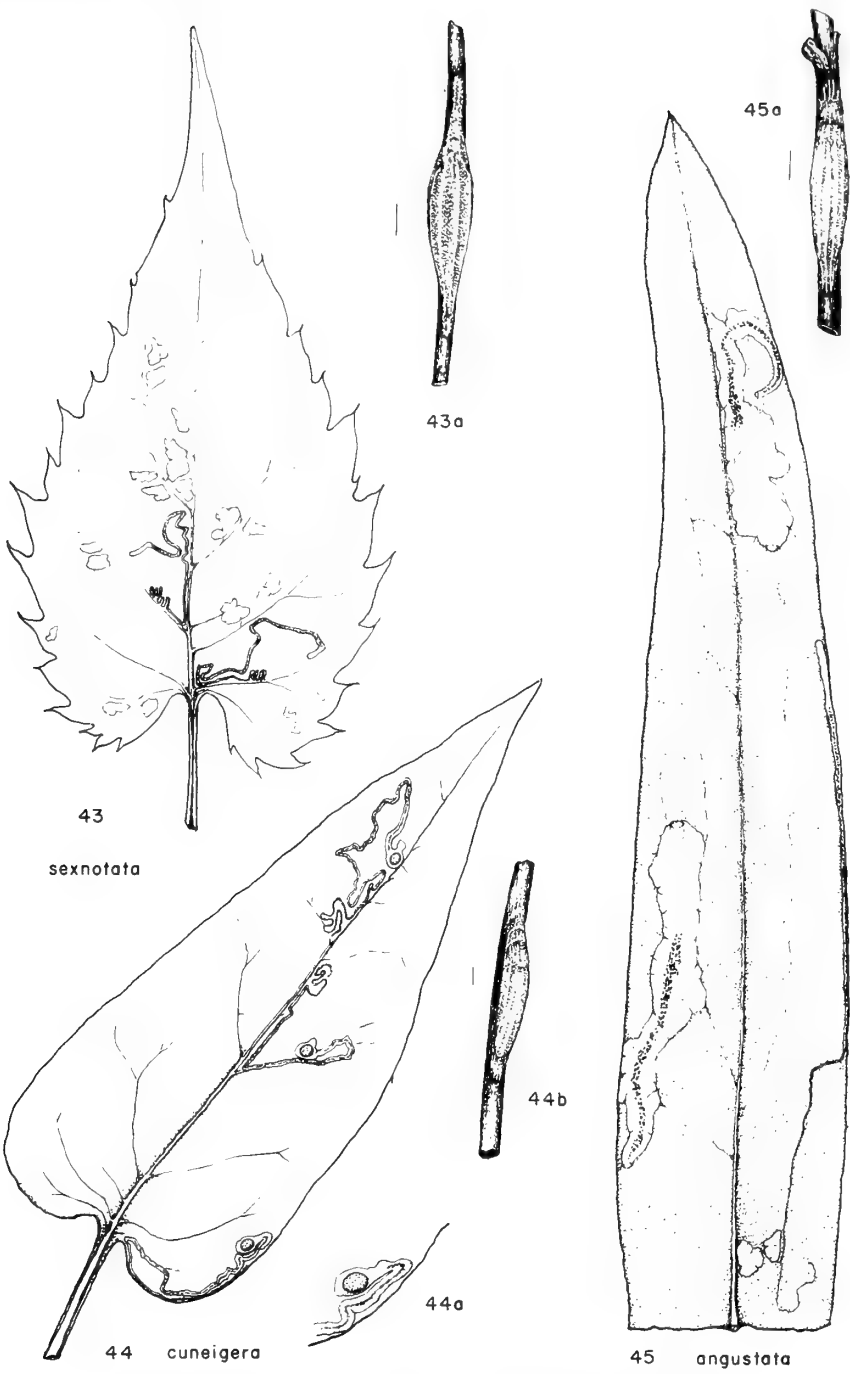


41 fusicola



42 needhami

42a



BRAUN-BUCCULATRIX IN NORTH AMERICA



46a



46c

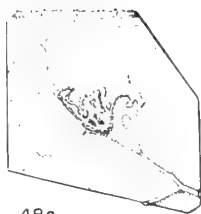


46b

46 speciosa



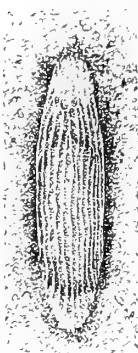
47



48a

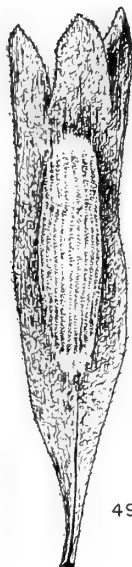


48b



48c

48
divisa



49

tridenticola



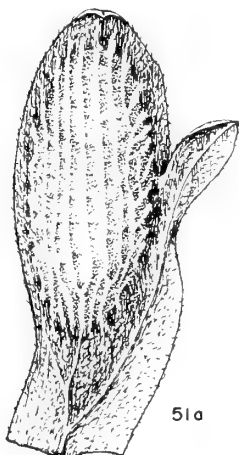
50

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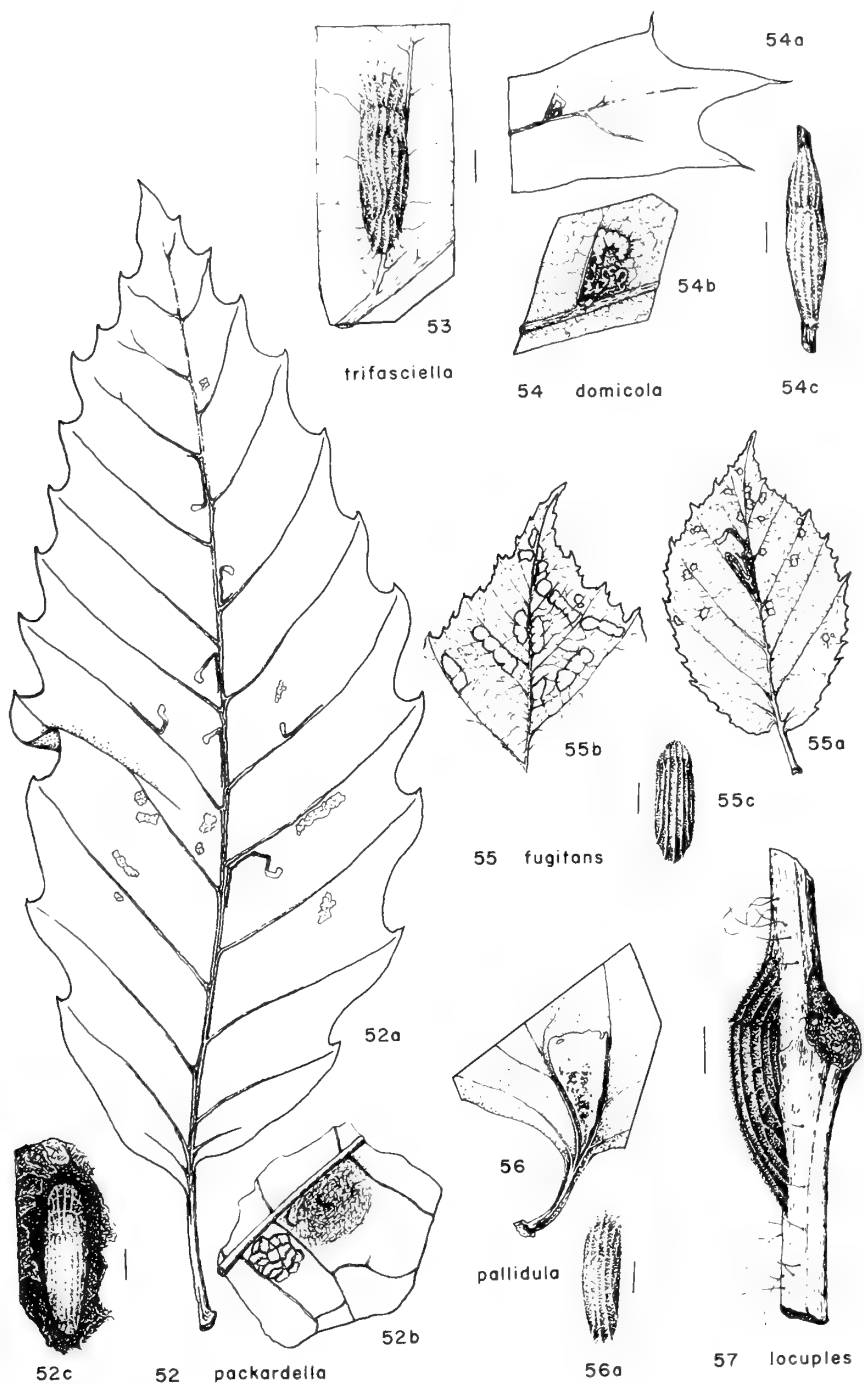


51

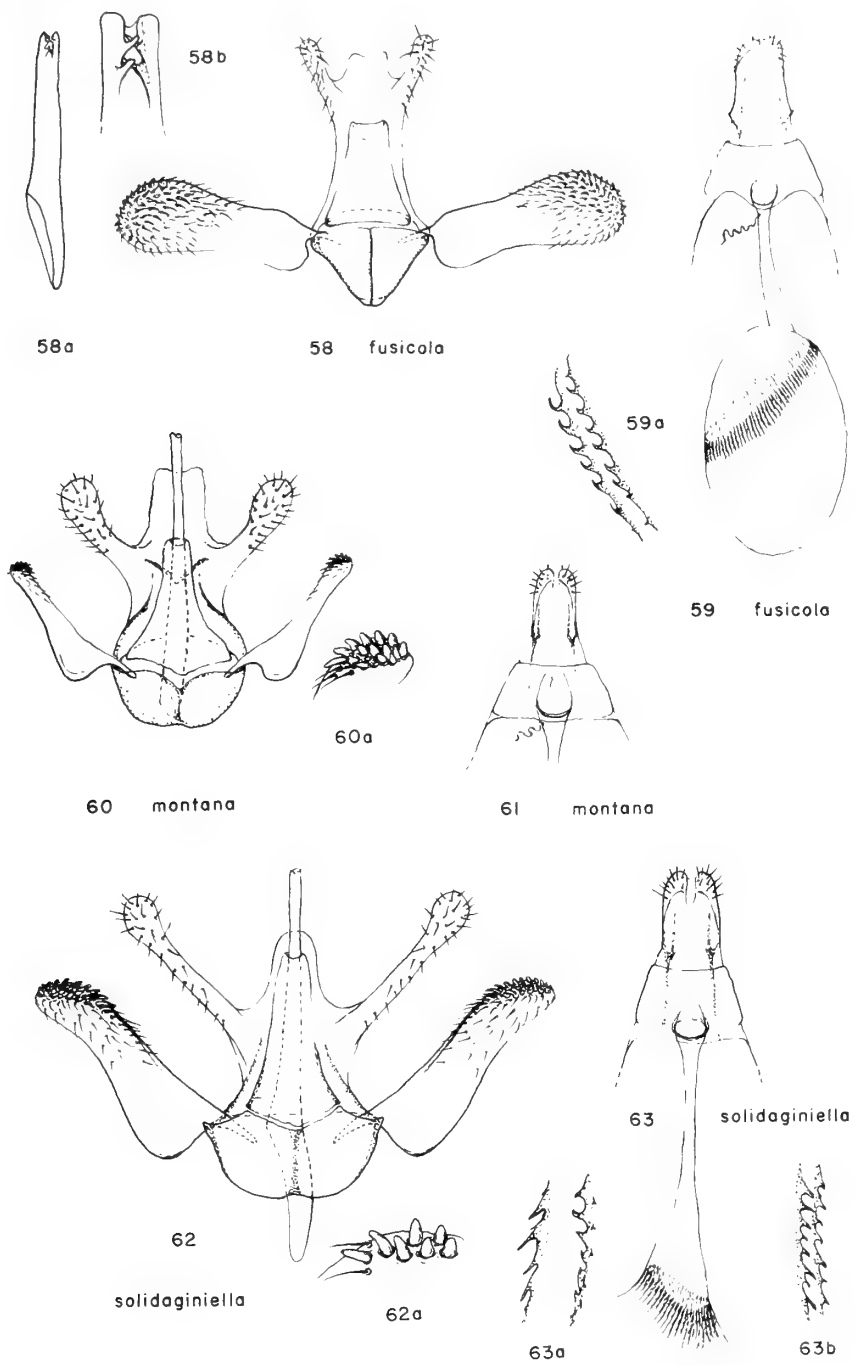
salutatoria



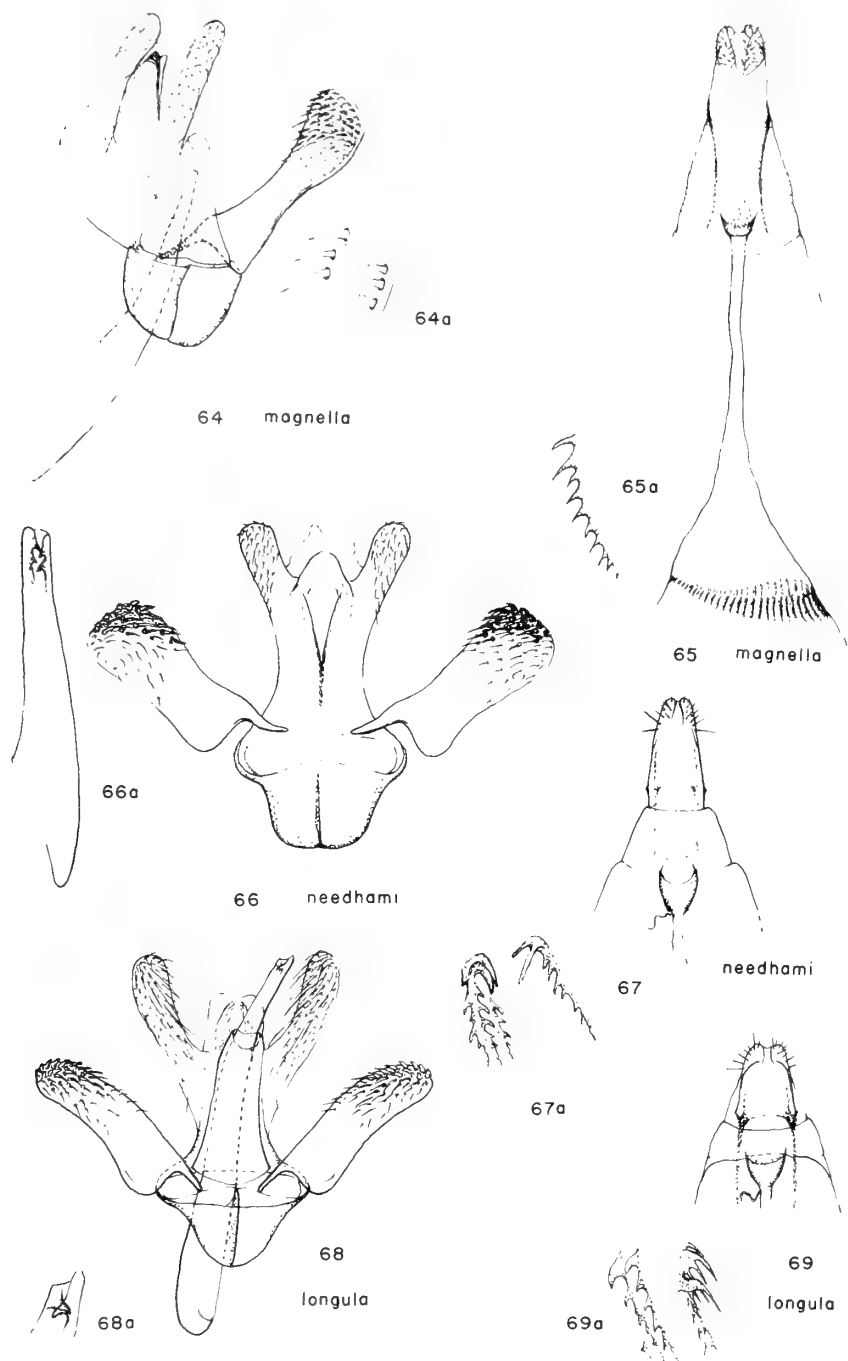
51a



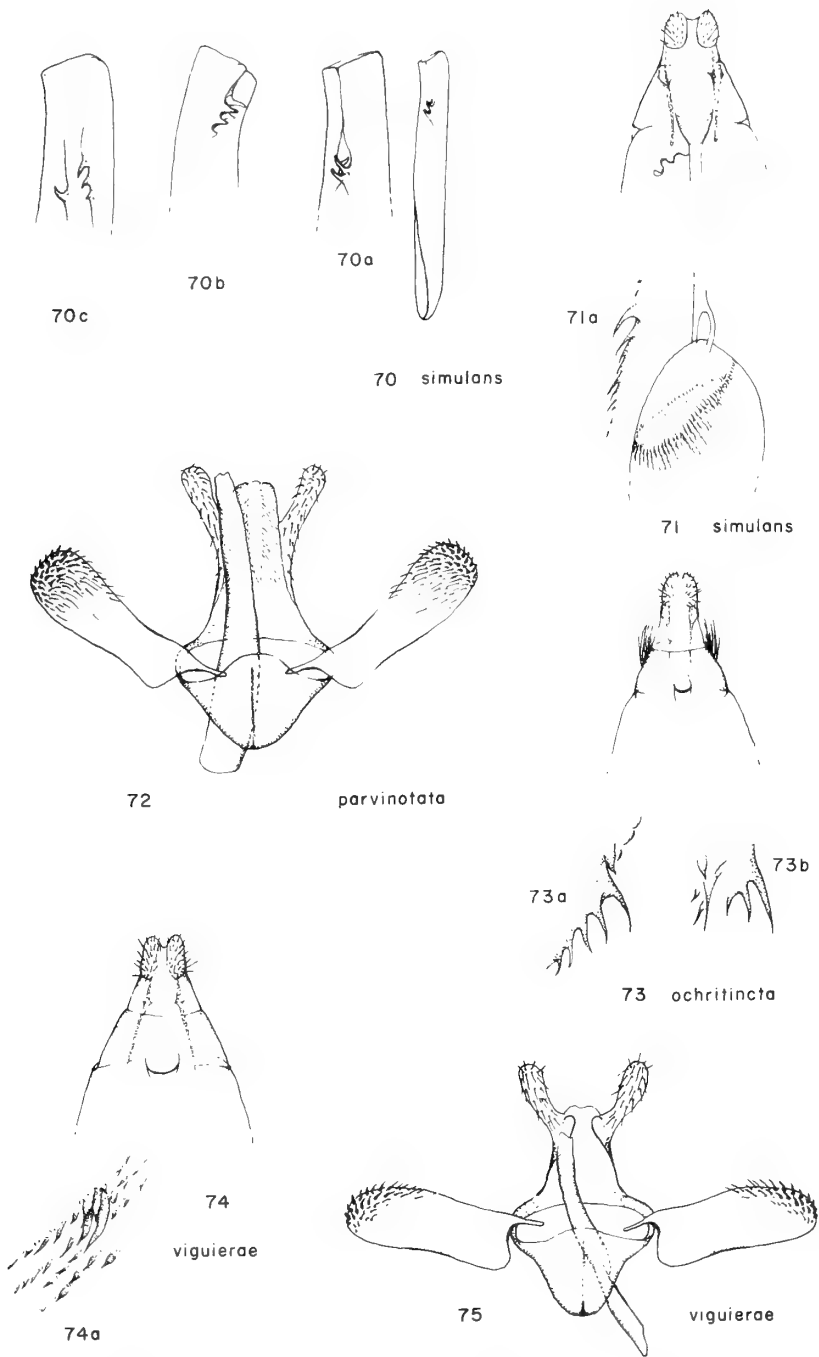
BRAUN—BUCCULATRIX IN NORTH AMERICA

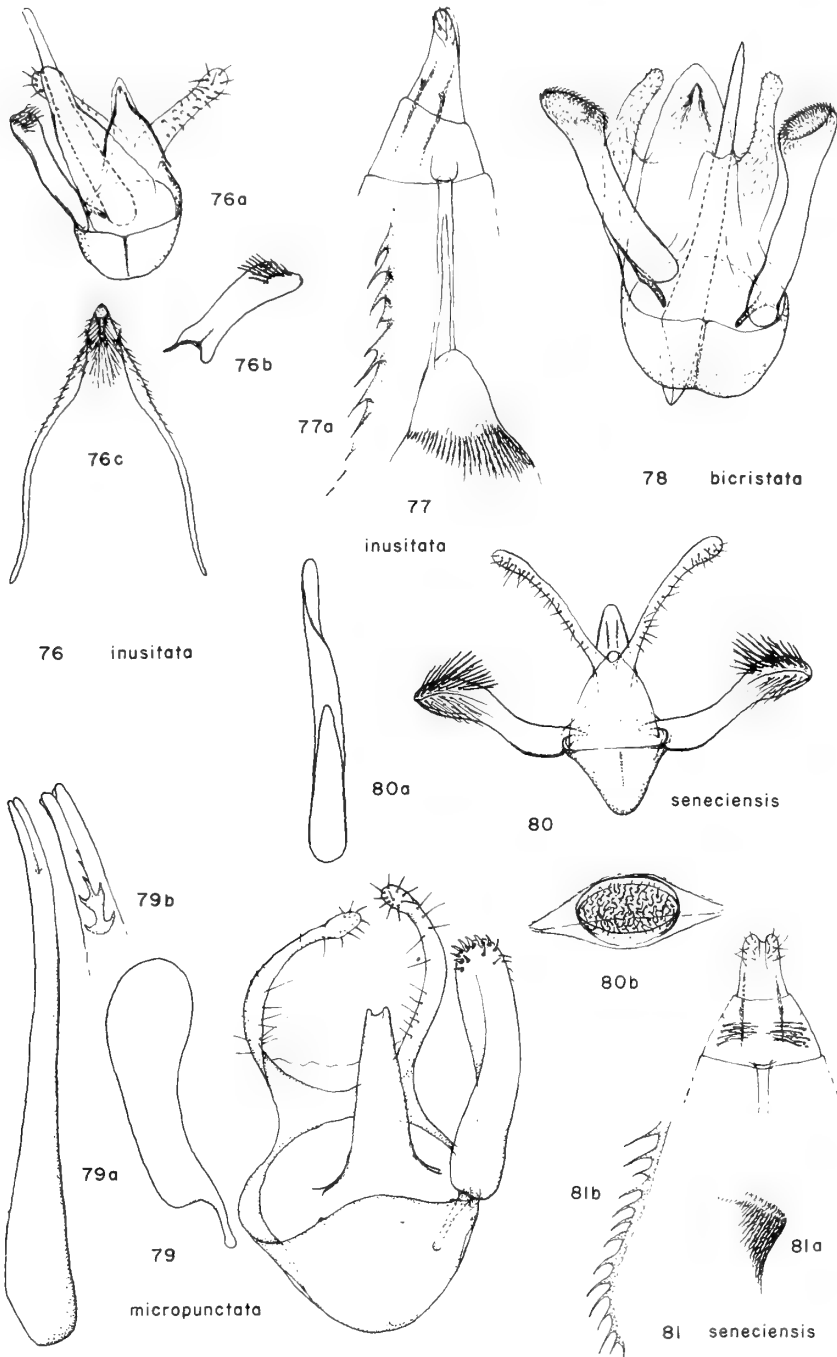


BRAUN—BUCCULATRIX IN NORTH AMERICA

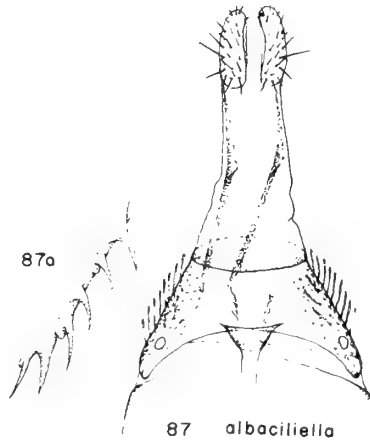
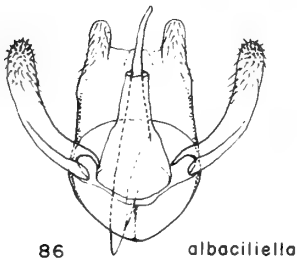
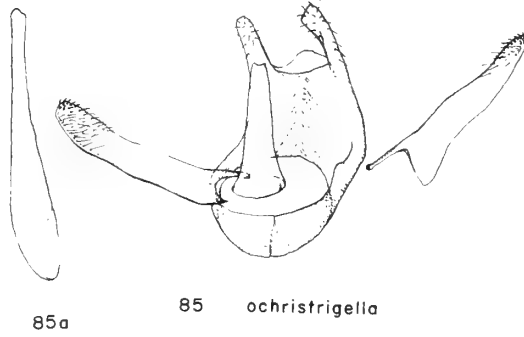
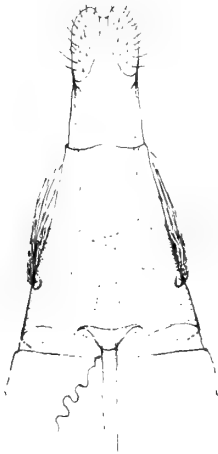
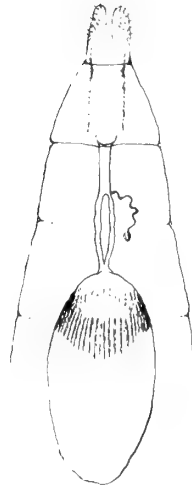
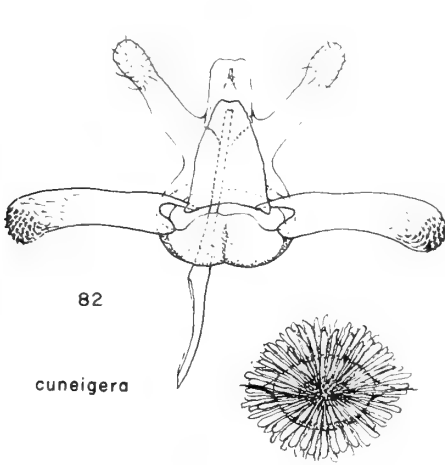


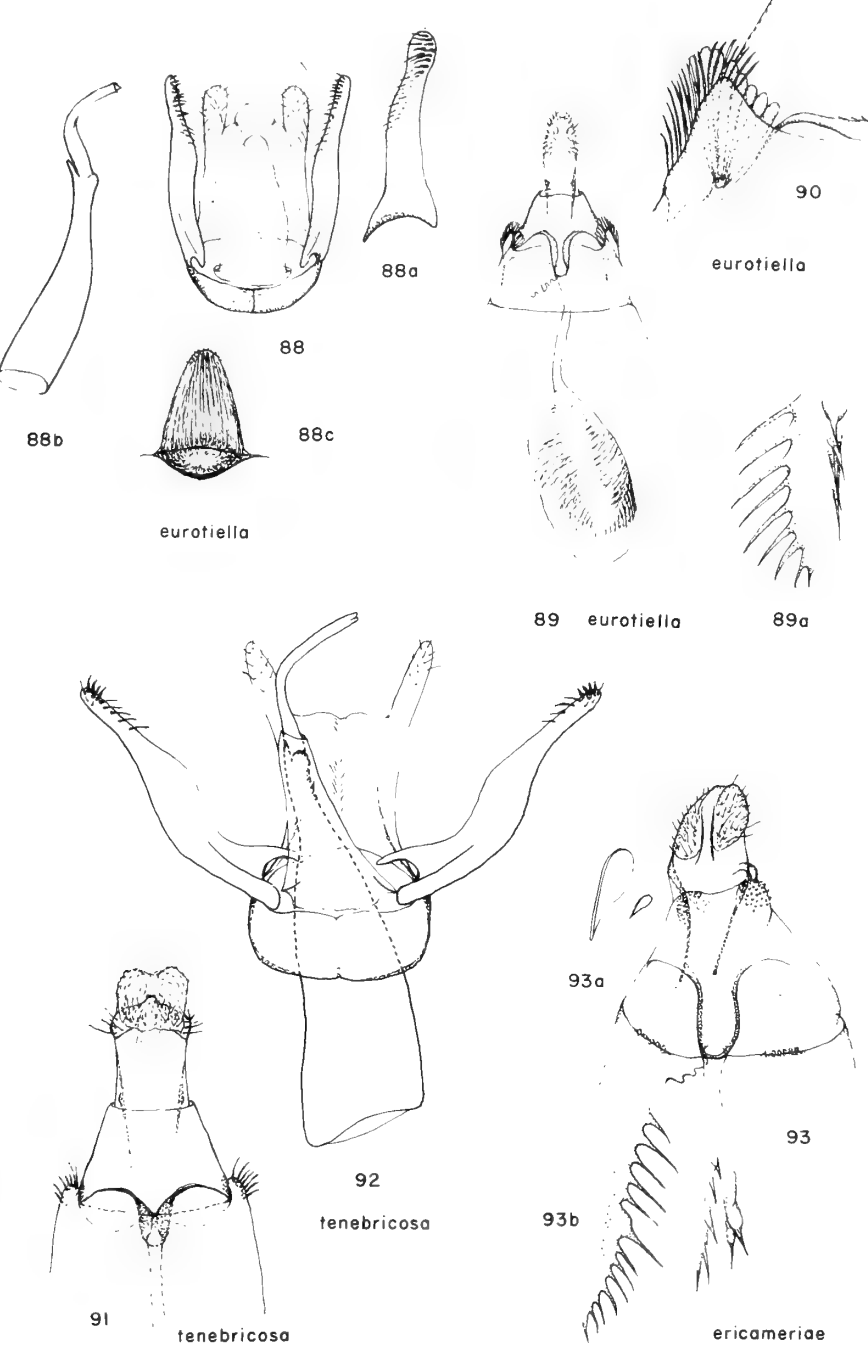
BRAUN—BUCCULATRIX IN NORTH AMERICA



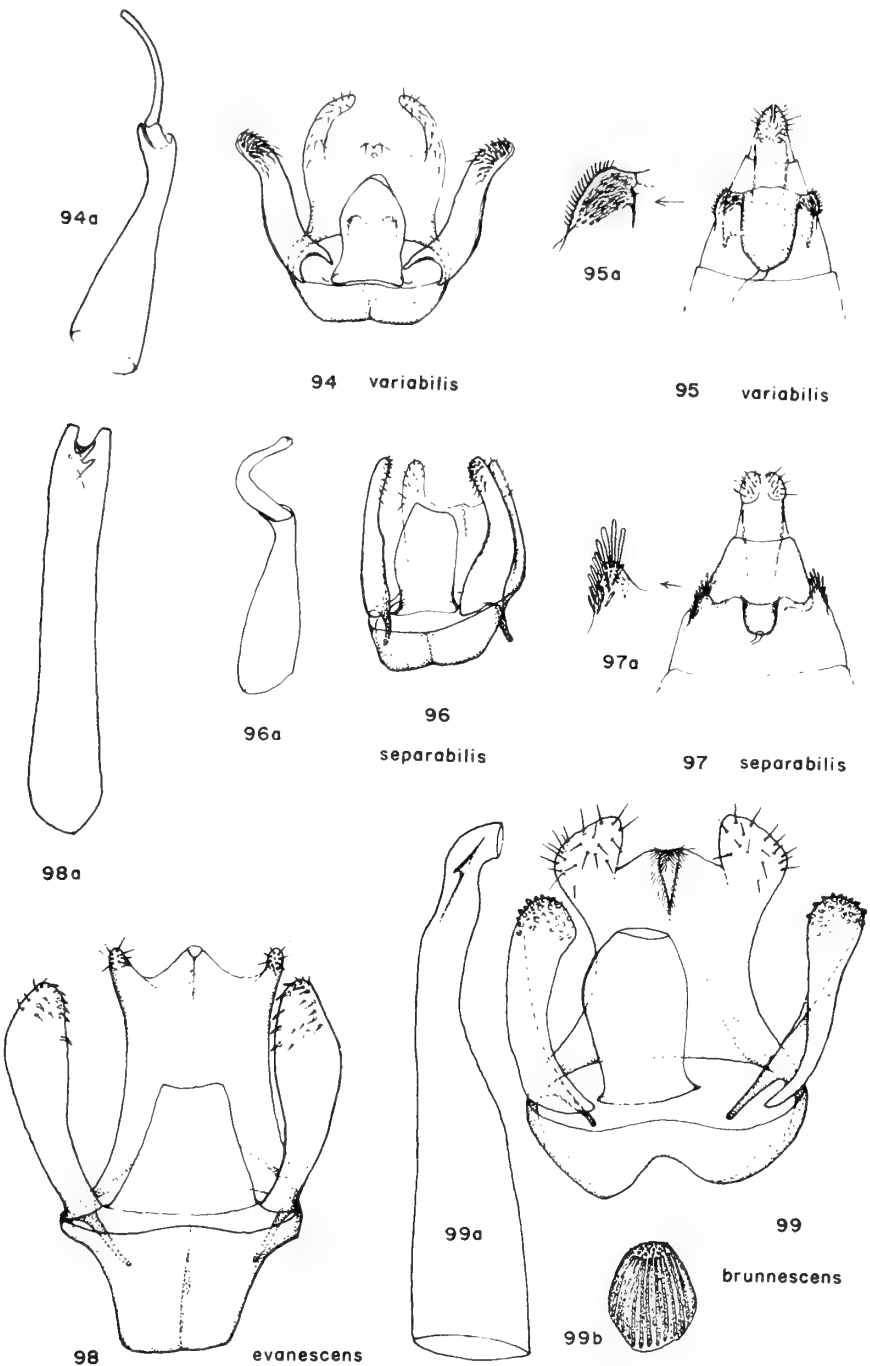


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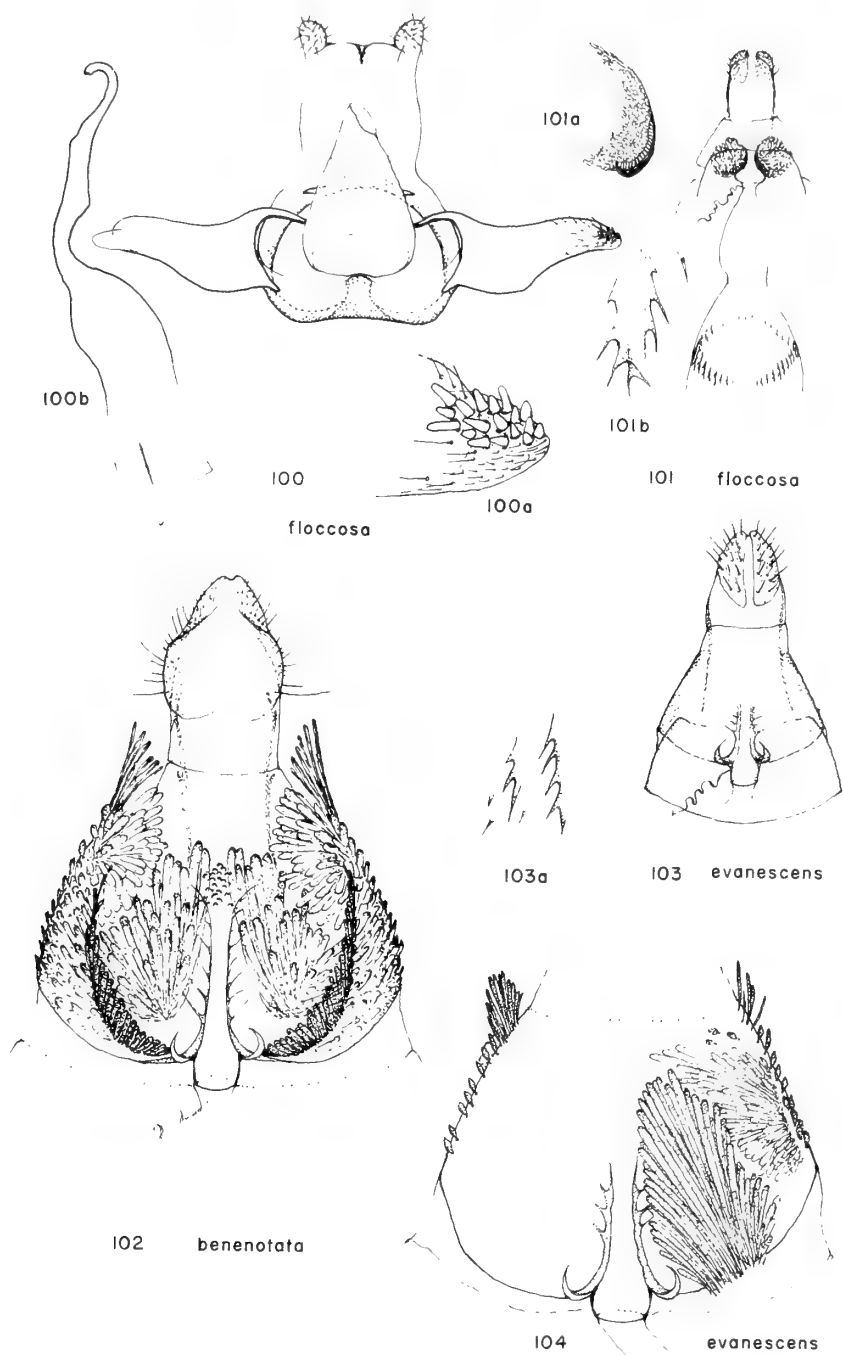


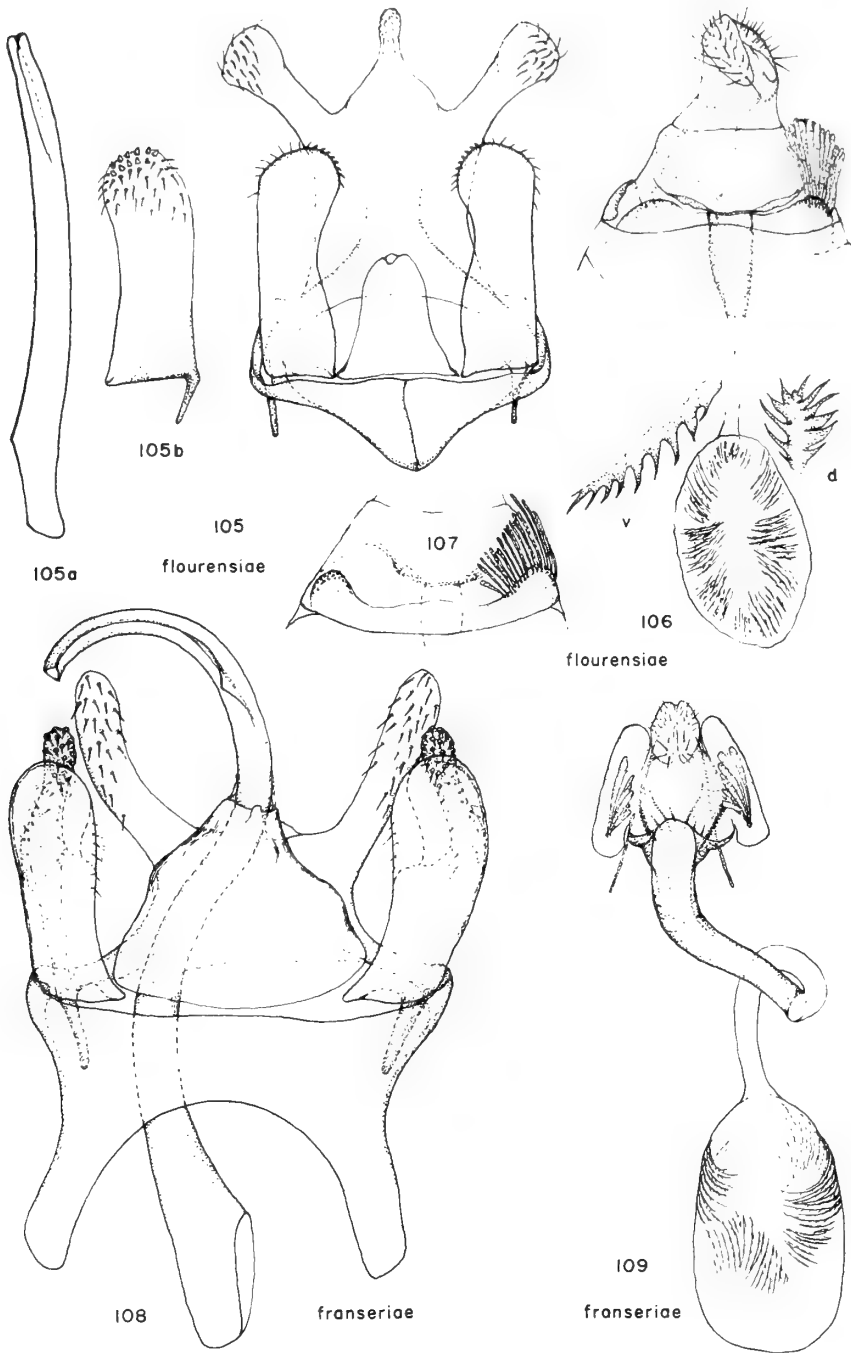


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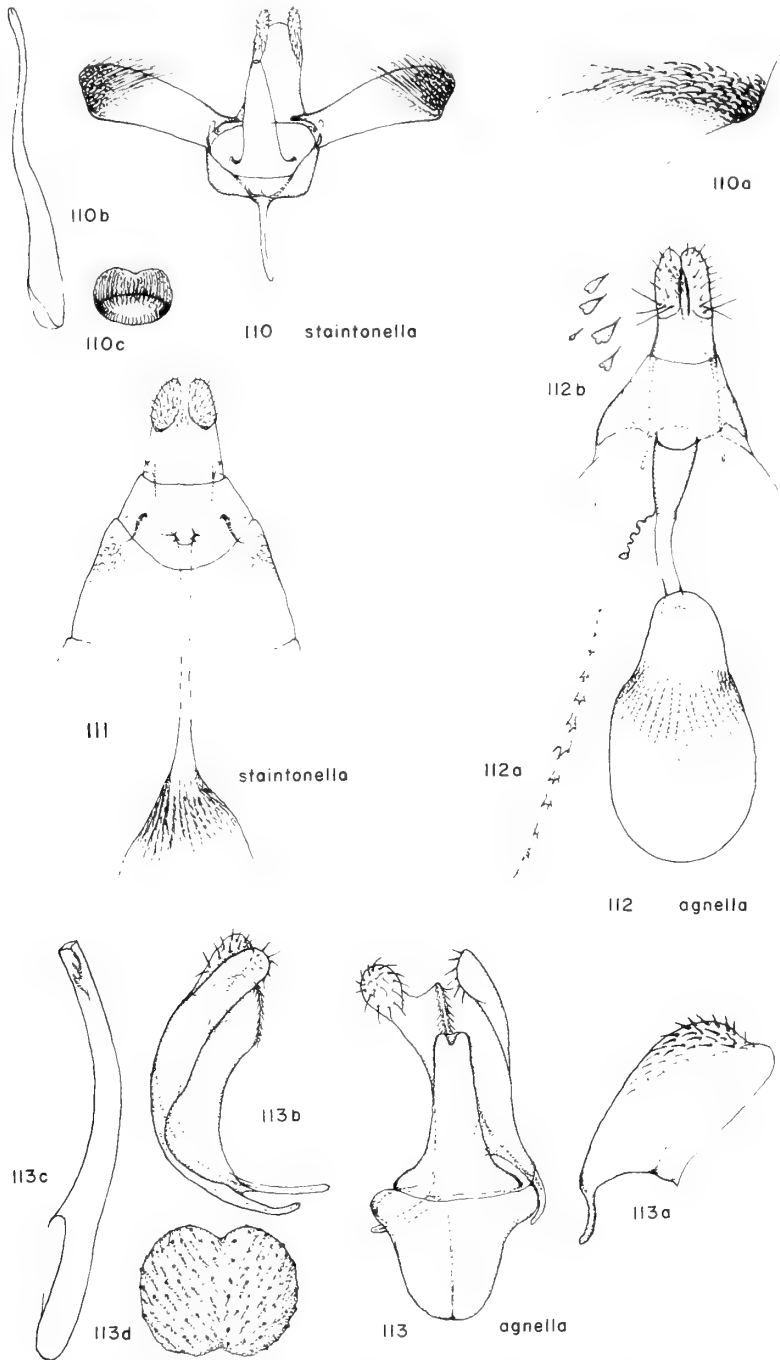


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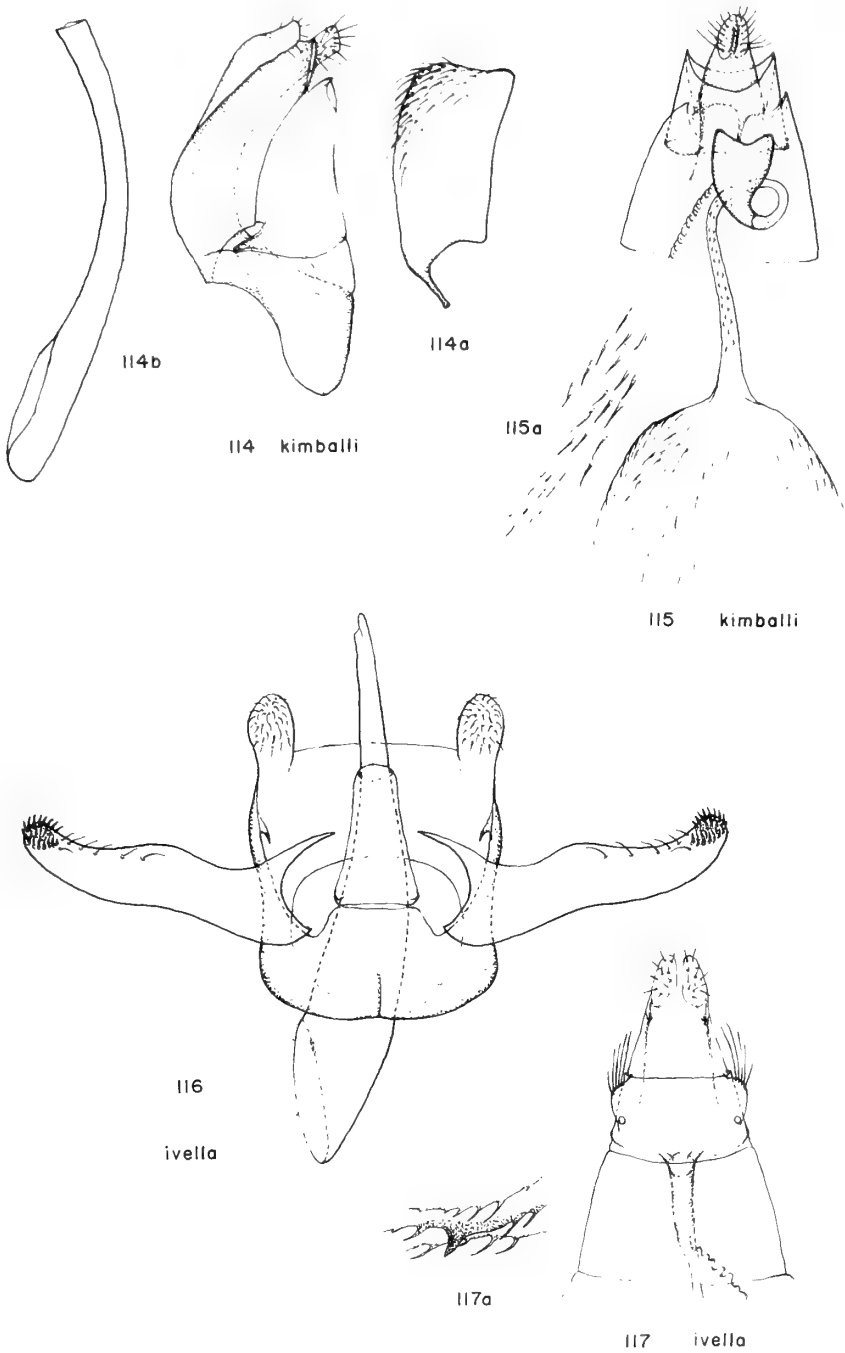


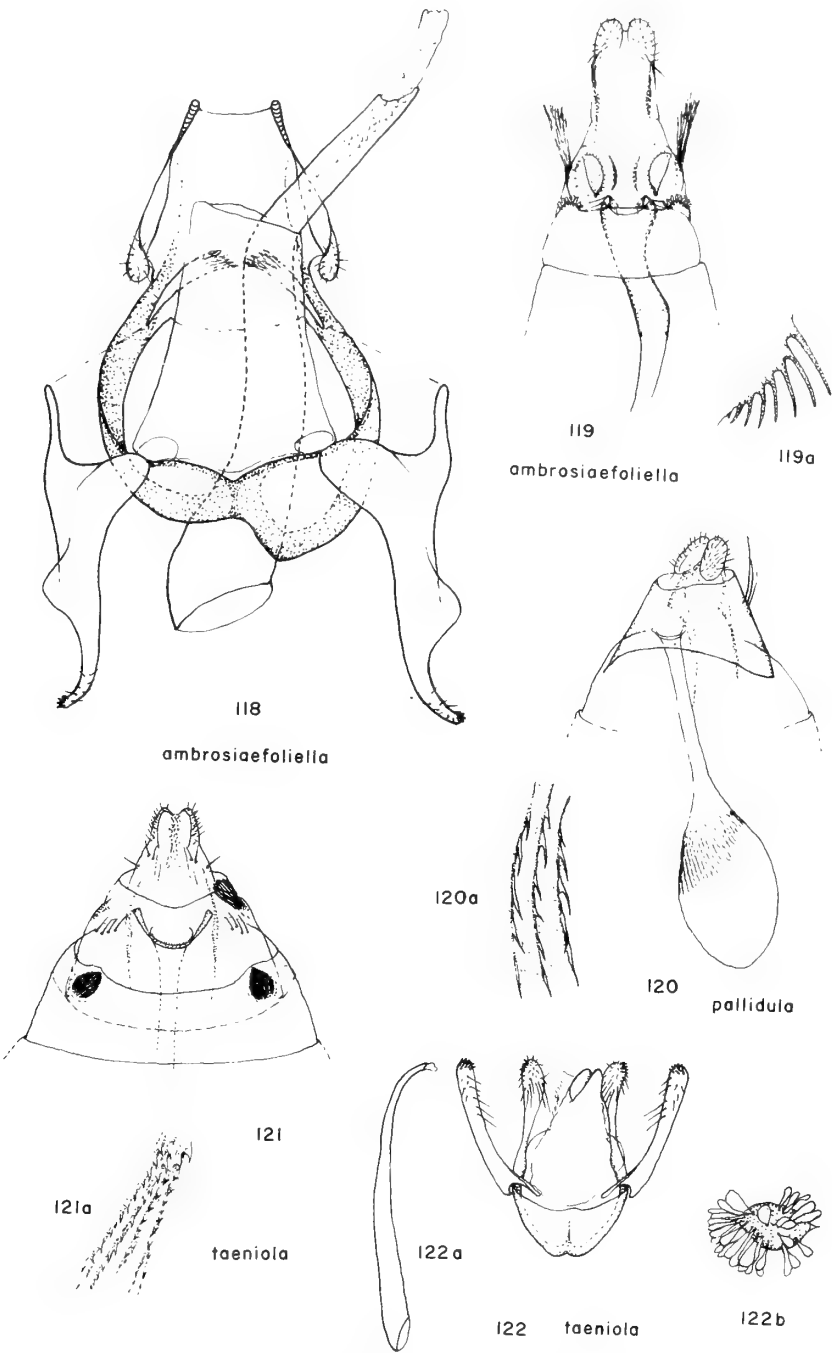


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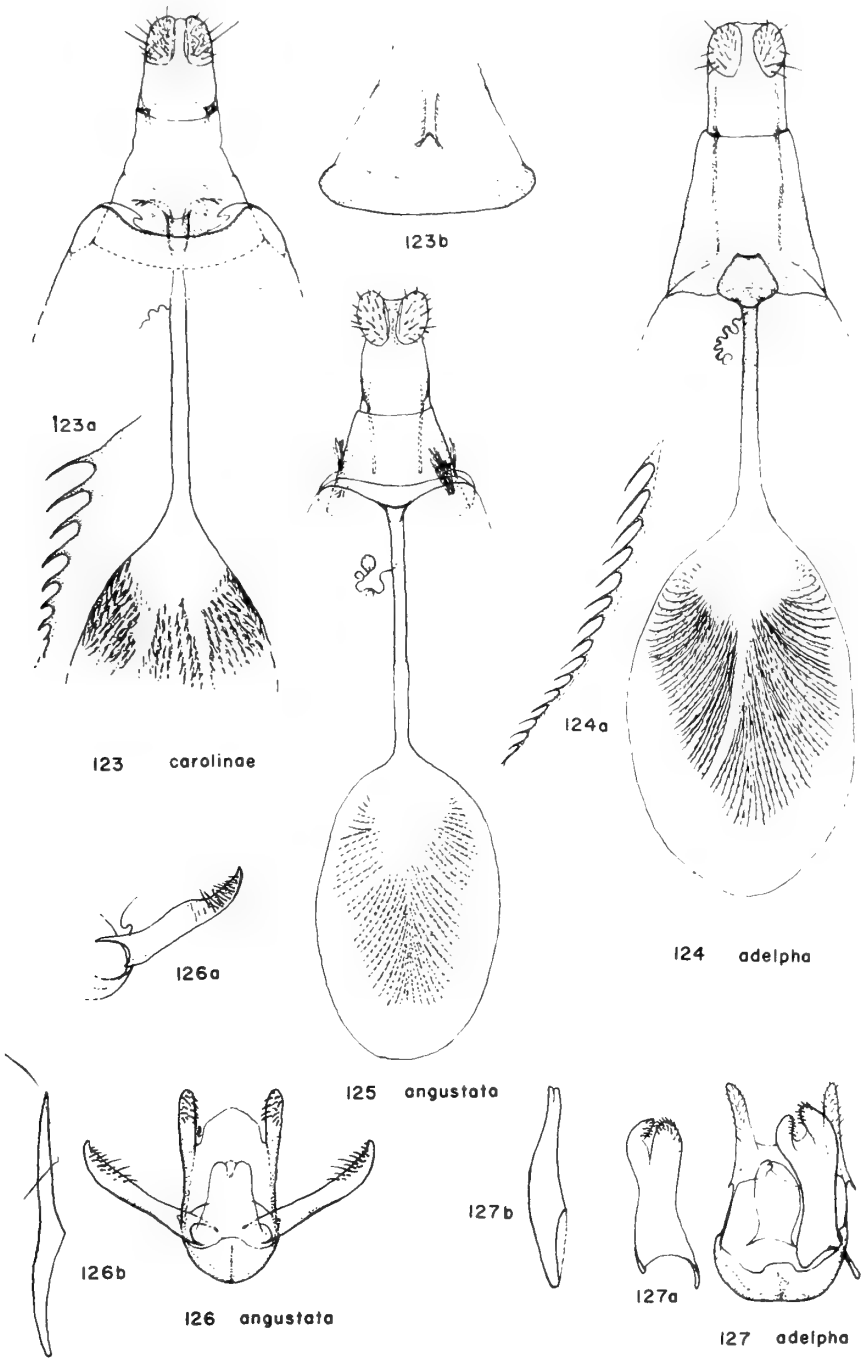


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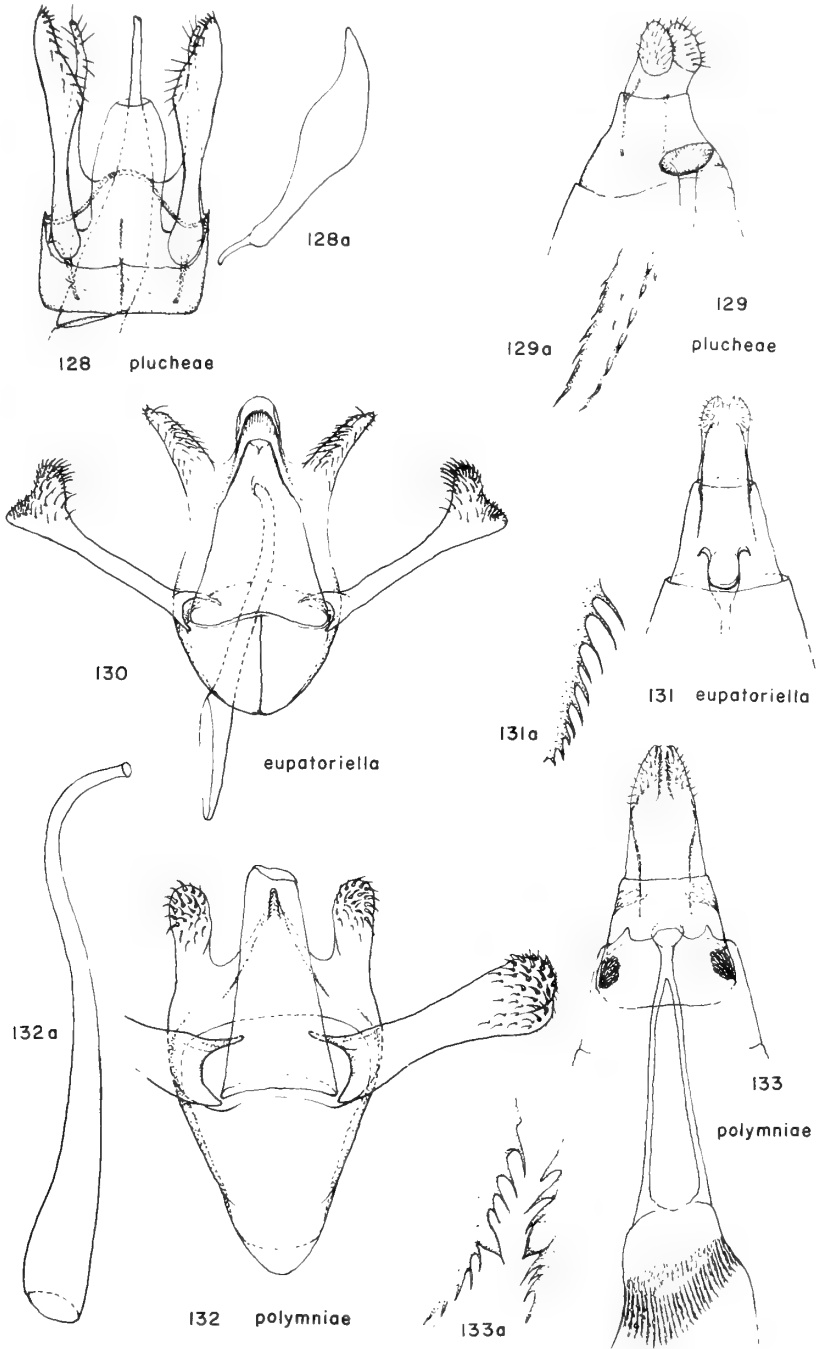




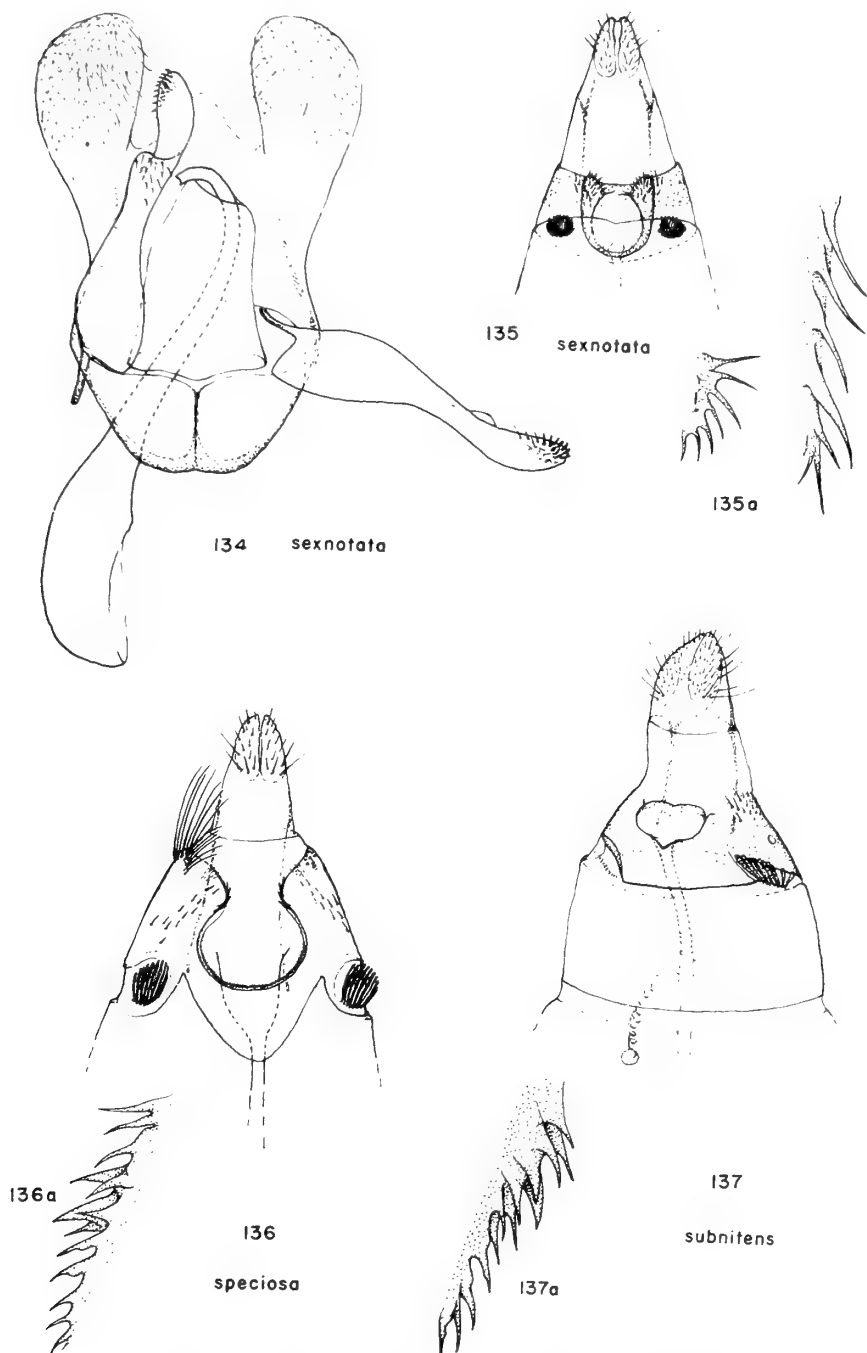
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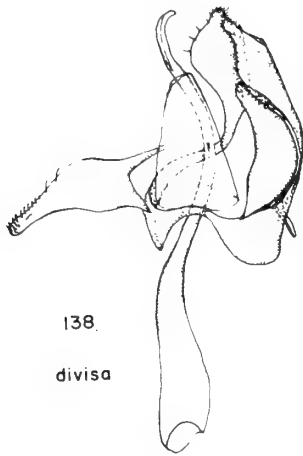
BRAUN—BUCCULATRIX IN NORTH AMERICA



BRAUN—BUCCULATRIX IN NORTH AMERICA

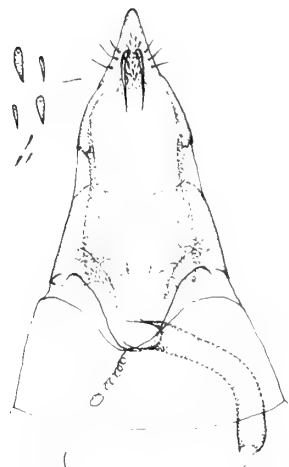


BRAUN—BUCCULATRIX IN NORTH AMERICA



138

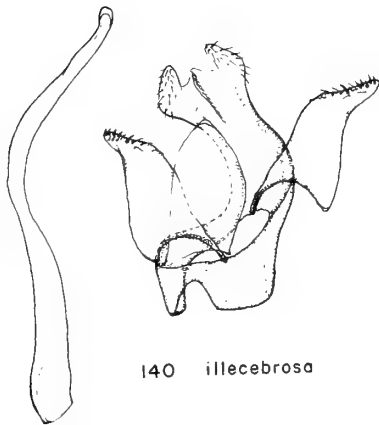
divisa



139a

139

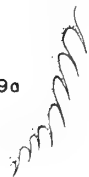
divisa



140

illecebrosa

140a

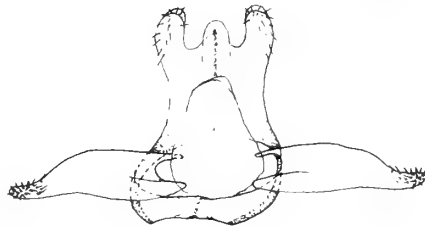


141

illecebrosa

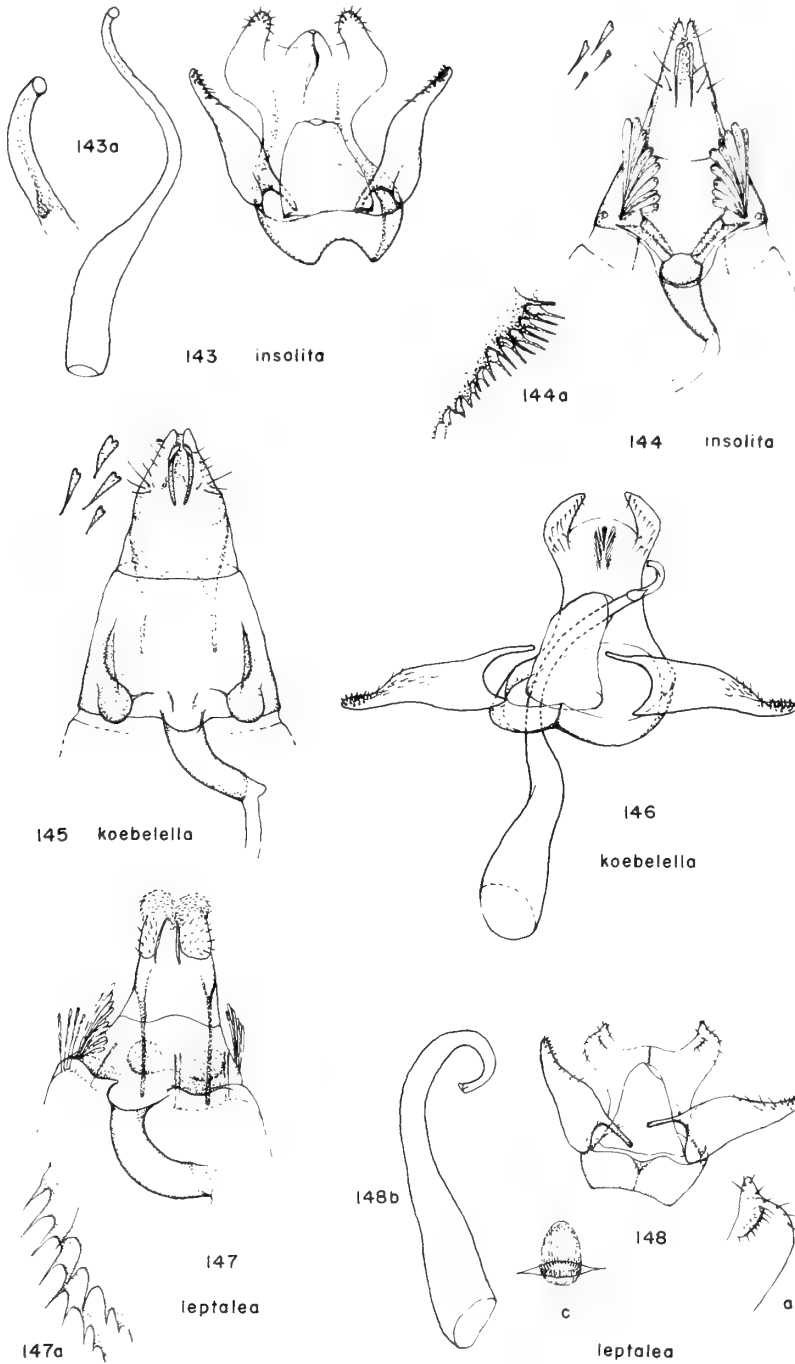


142a

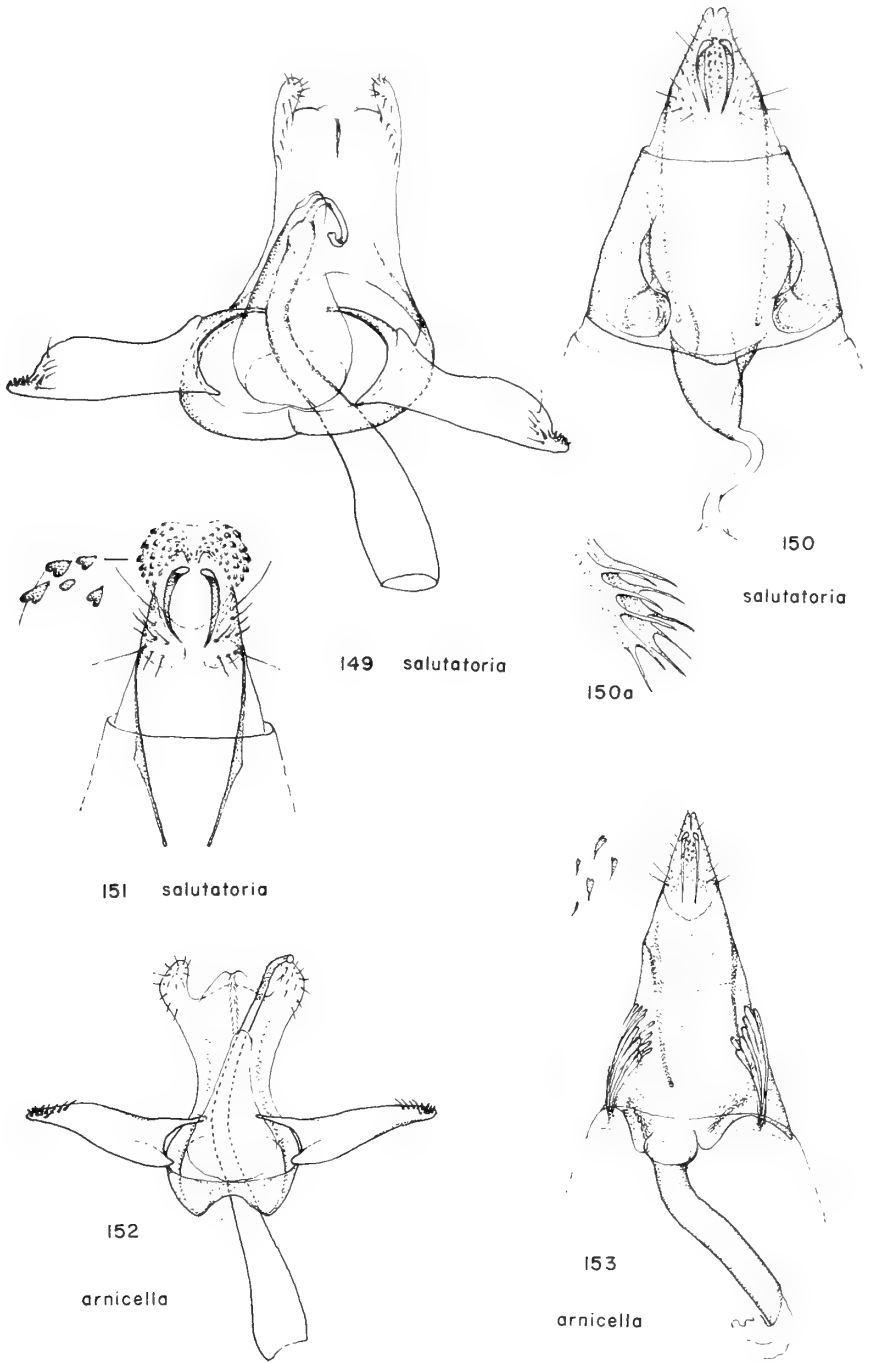


142

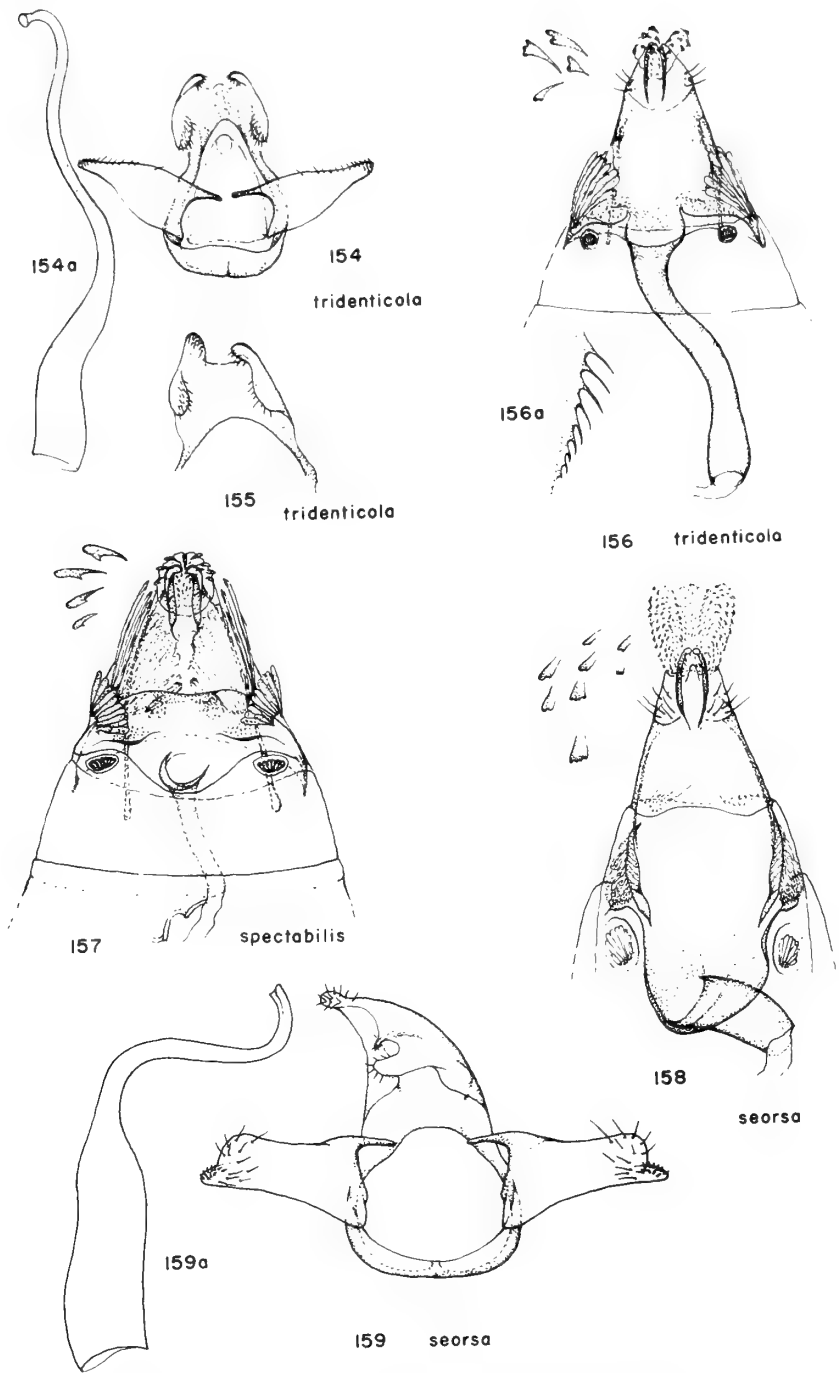
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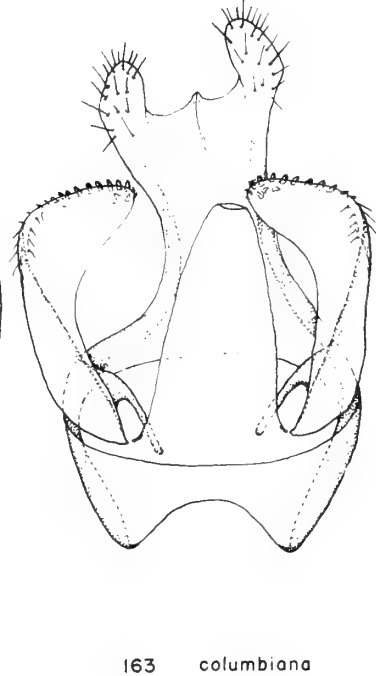
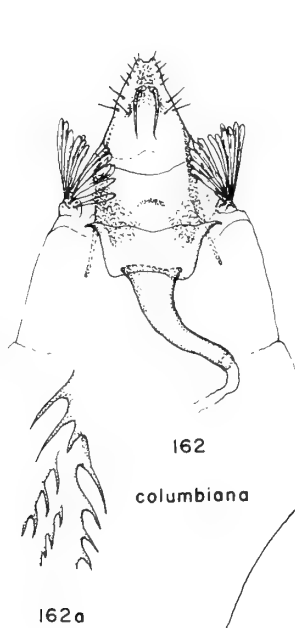
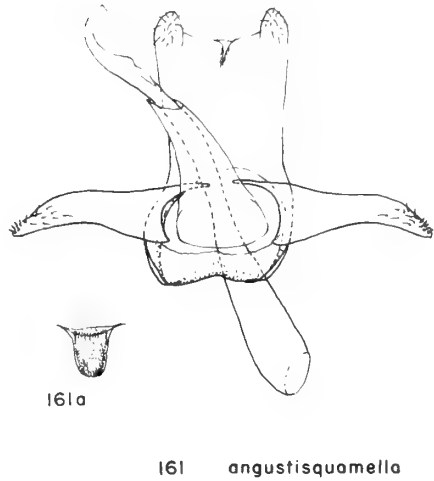
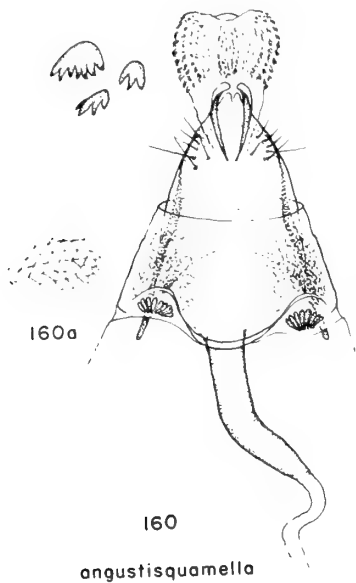


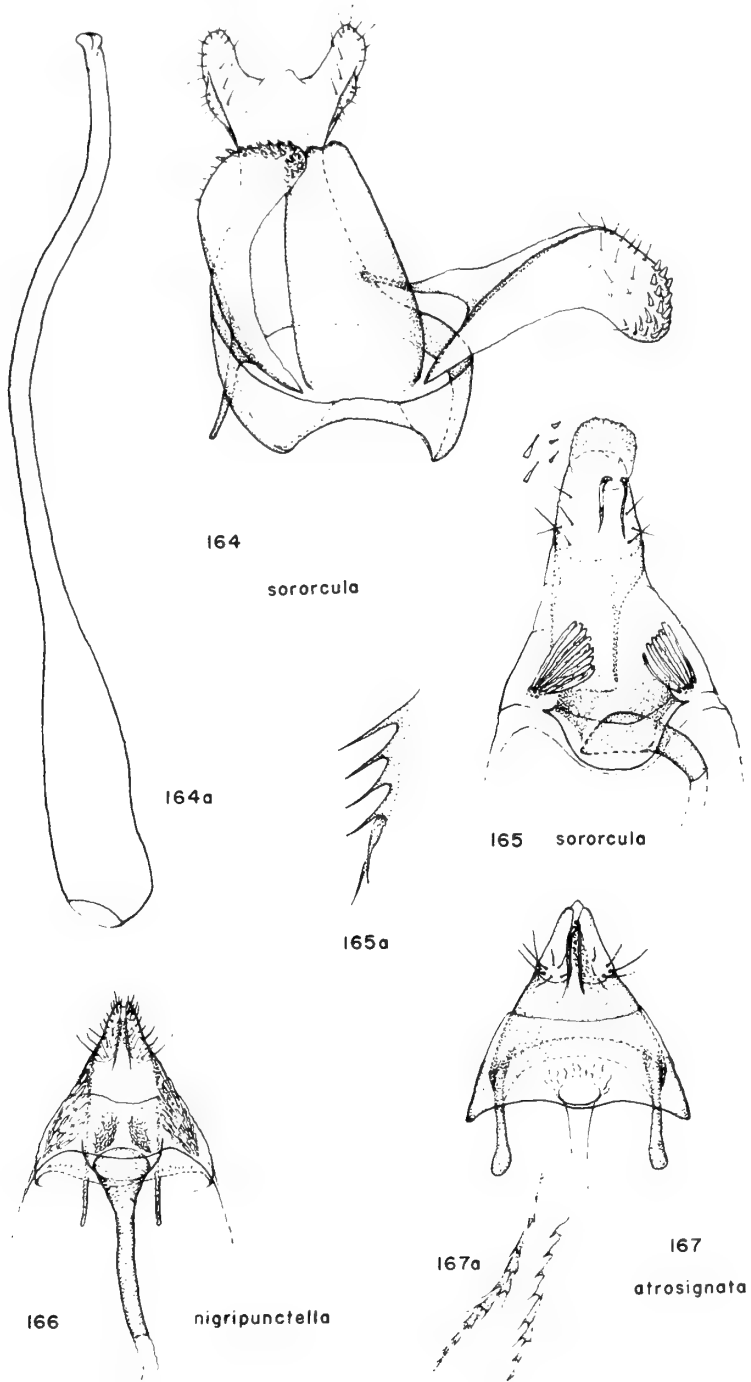
BRAUN—BUCCULATRIX IN NORTH AMERICA



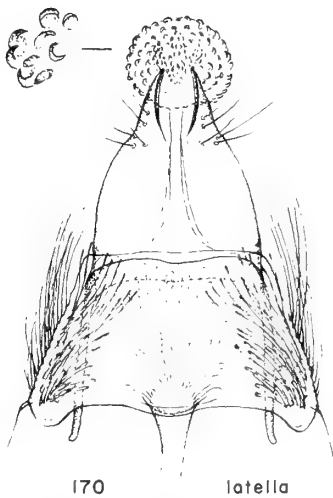
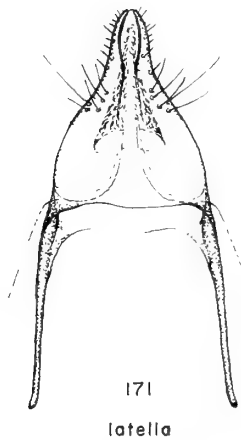
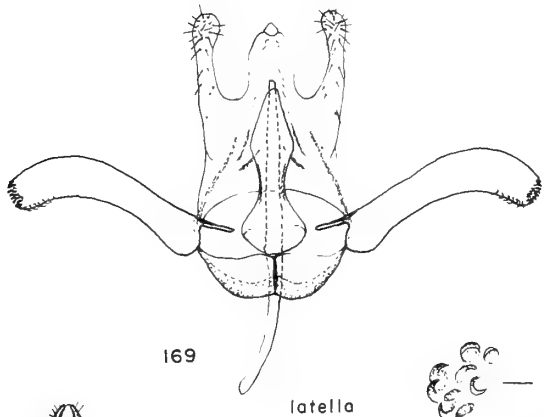
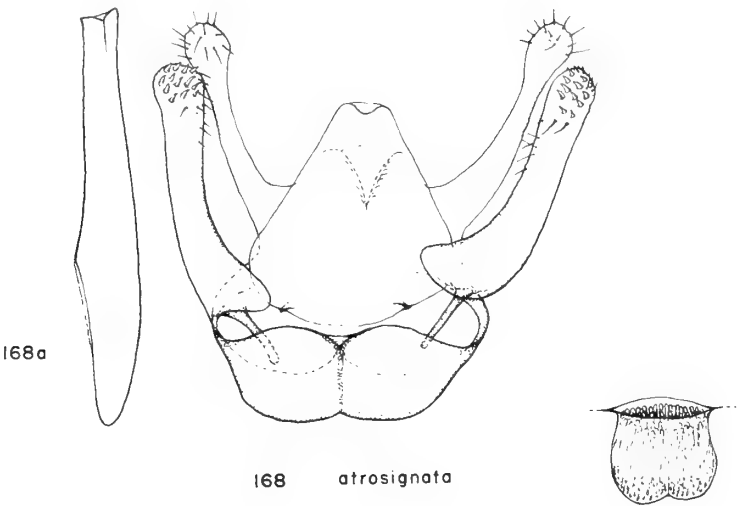
BRAUN—BUCCULATRIX IN NORTH AMERICA

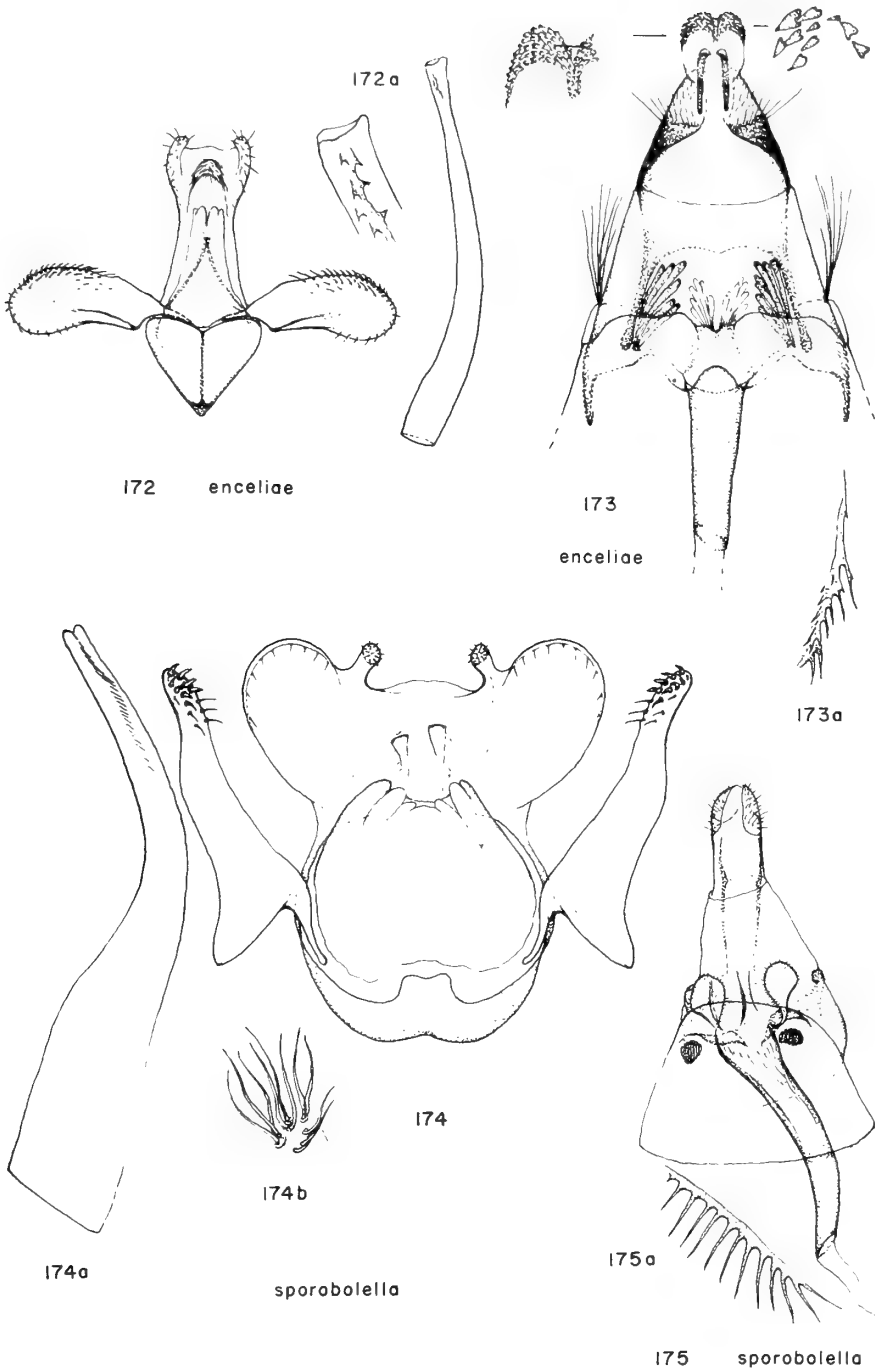


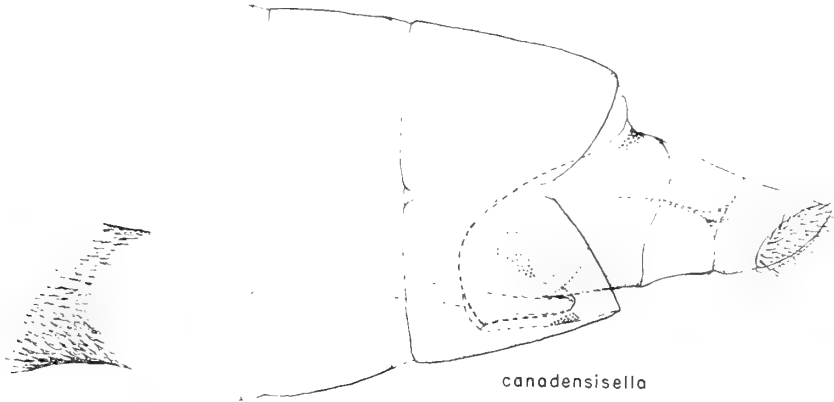




BRAUN—BUCCULATRIX IN NORTH AMERICA



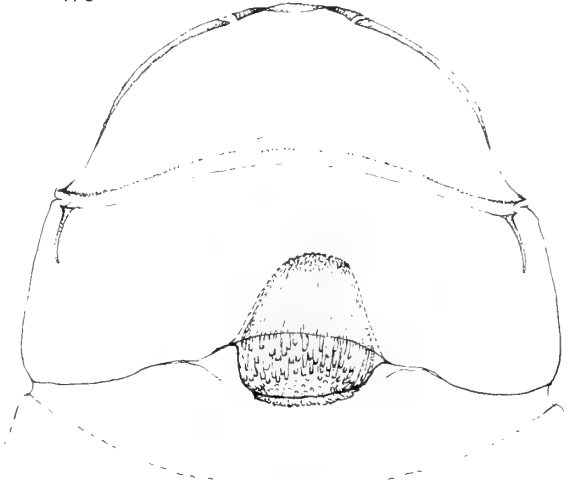




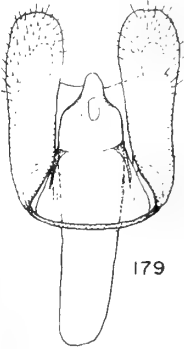
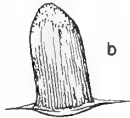
176



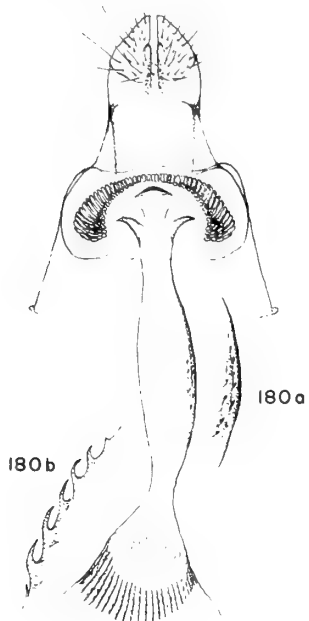
178 packardella



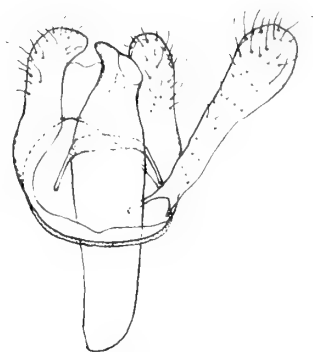
eugrapha



packardella



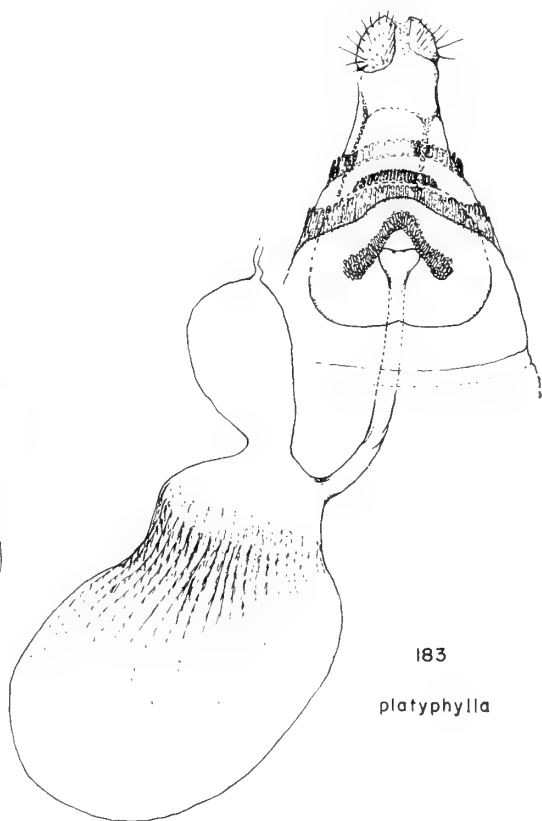
180 *albertiella*



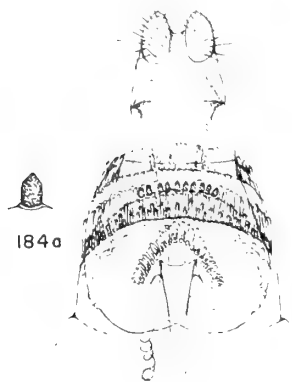
181 *albertiella*



182 *ochrisuffusa*



183
platyphylla

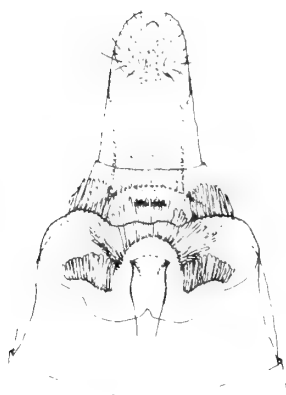


184a

184



185a

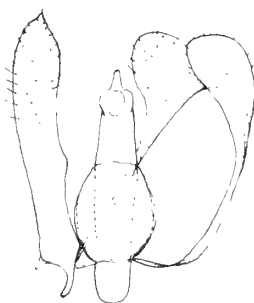


185 trifasciella



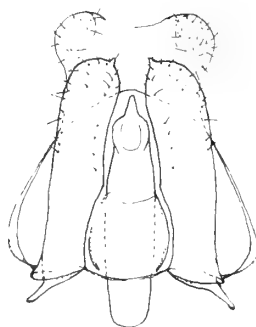
184b

coniforma

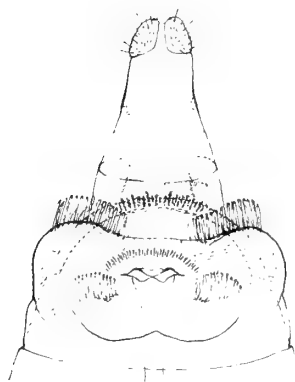


186a

trifasciella

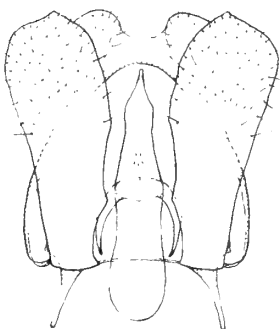


186



187

quinquenotella



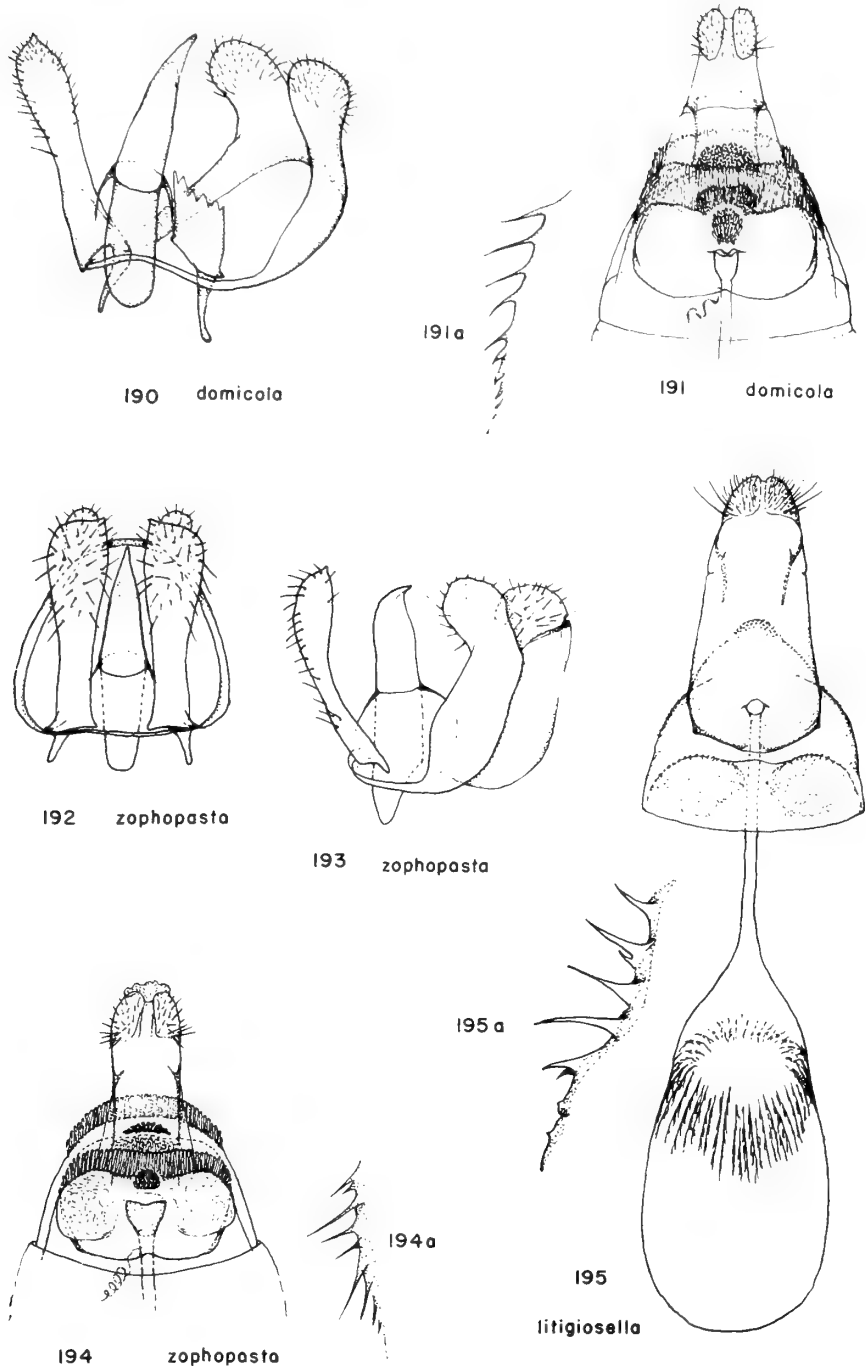
188

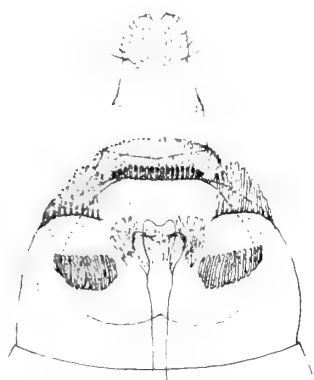
quinquenotella



189

quinquenotella

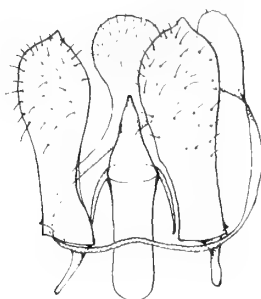




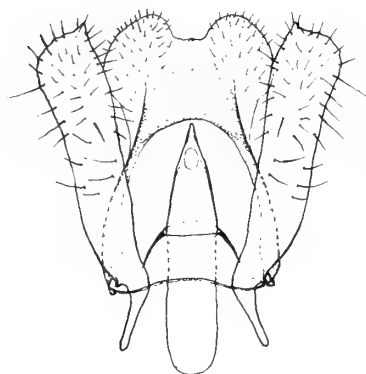
196 coronatella



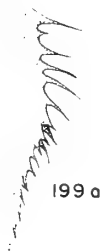
196 a



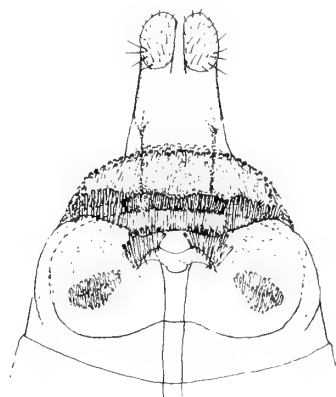
197 coronatella



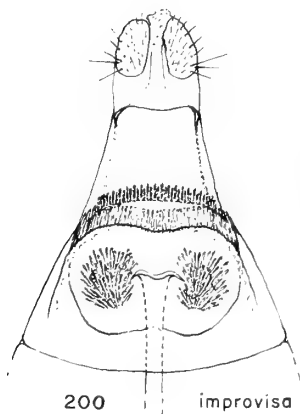
198 canadensisella



199 a



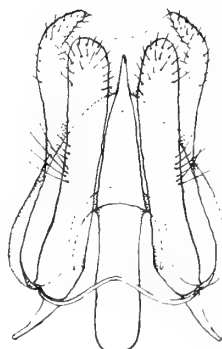
199 canadensisella



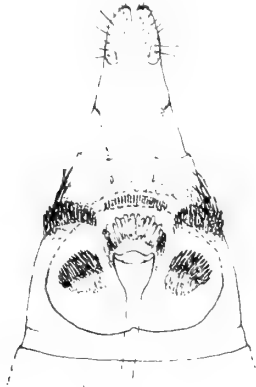
200 improvisa



200 a



201 improvisa

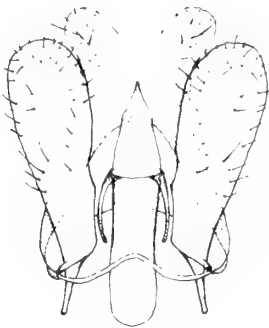


202

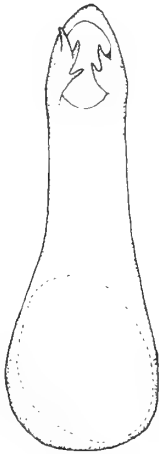
polytita



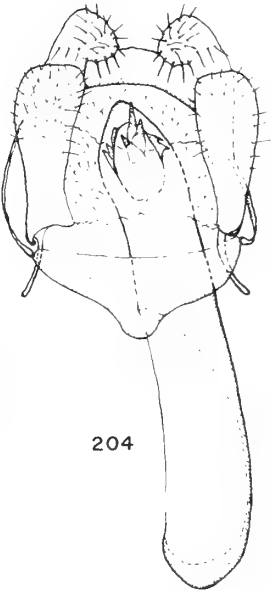
202 a



203 polytita

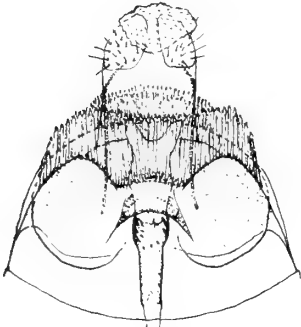


204 a



204

recognita

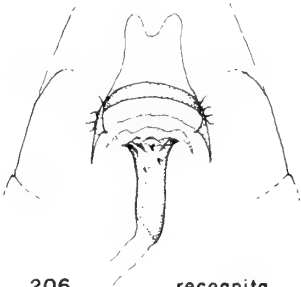


205



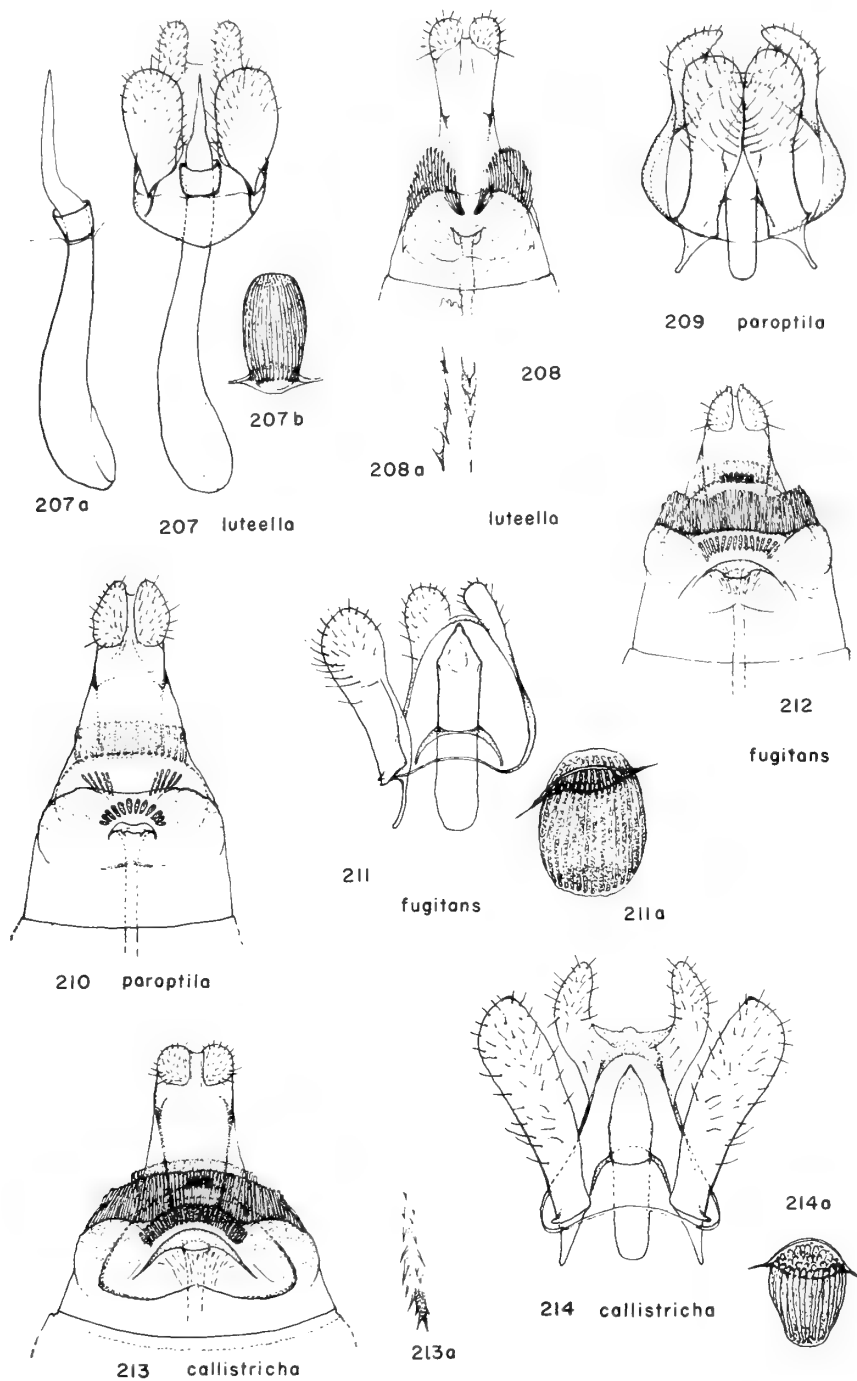
205 a

recognita

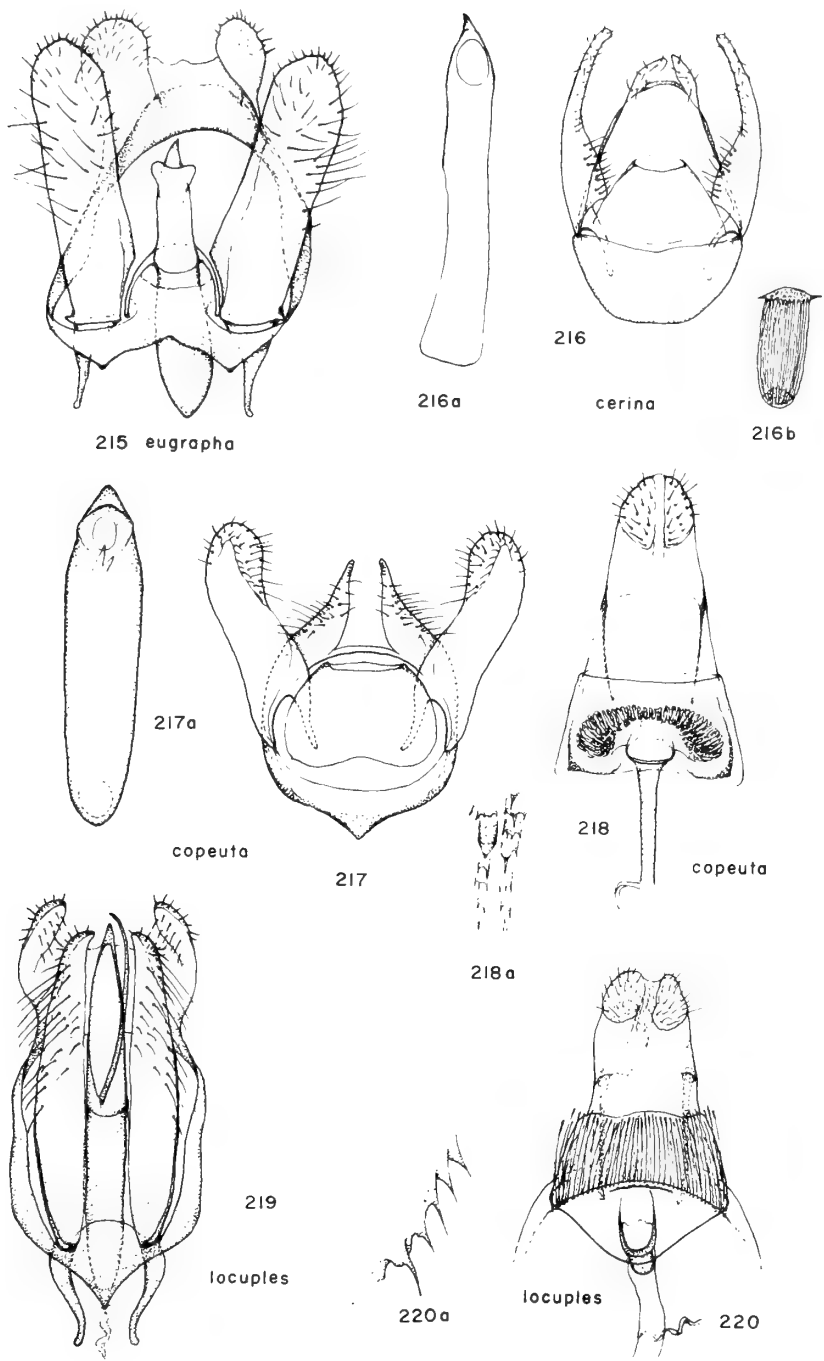


206

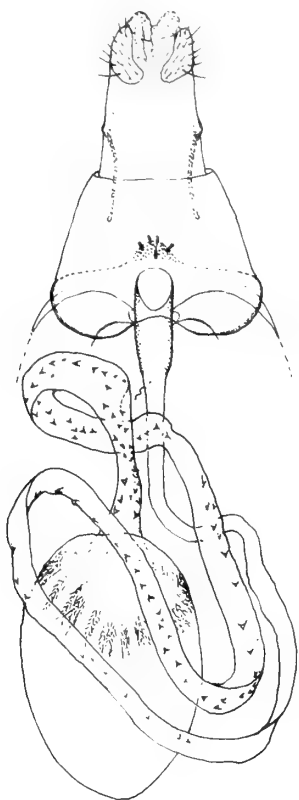
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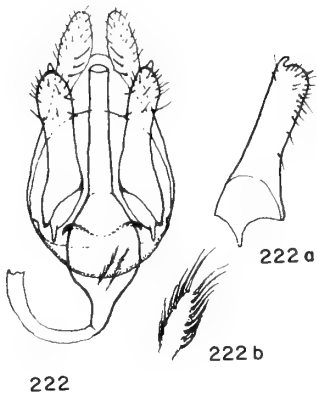
BRAUN—BUCCULATRIX IN NORTH AMERICA



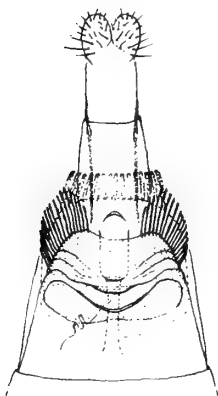
BRAUN—BUCCULATRIX IN NORTH AMERICA



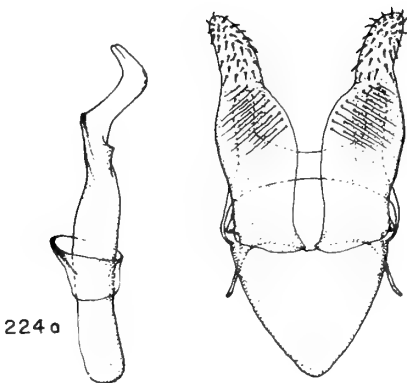
221 ainsliella



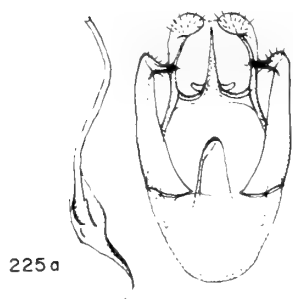
ainsliella



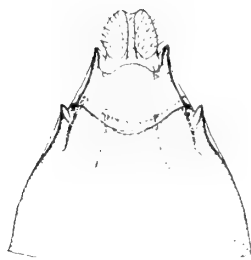
223 eclecta



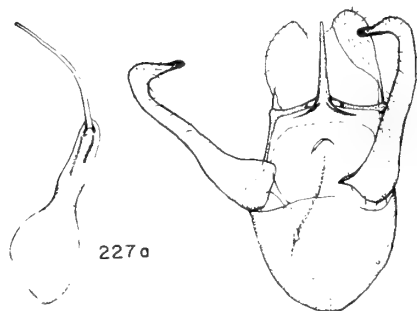
224 eclecta



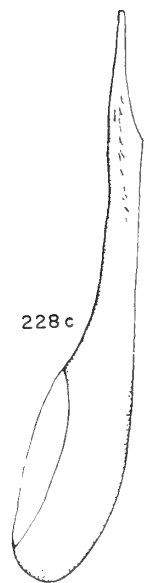
225 anaticula



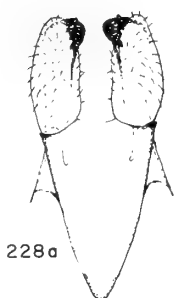
226 anaticula



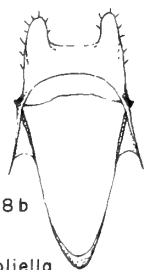
227 disjuncta



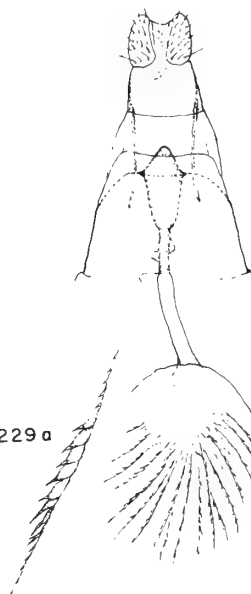
228 pomifoliella



228b



229a



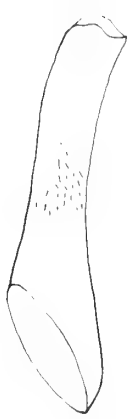
229 pomifoliella



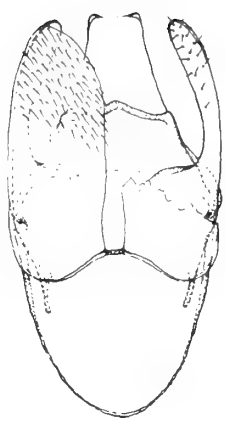
230 ceanothiella



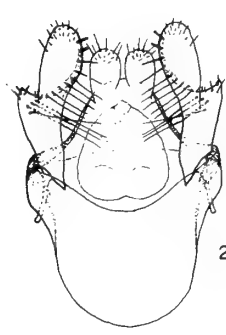
231 ilecella



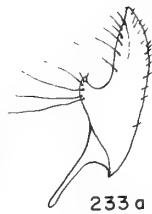
232 a



232 ilecella

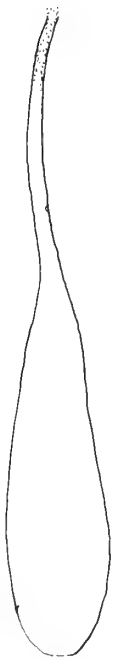


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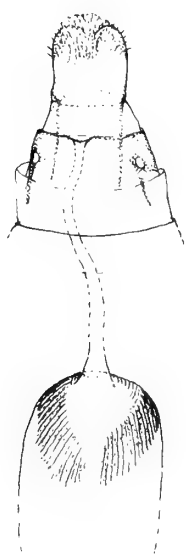


233 a

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233 b

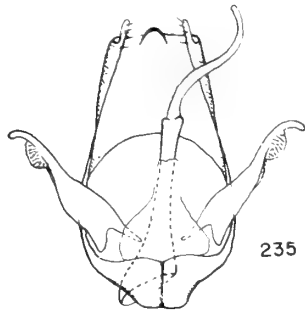


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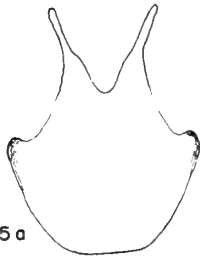


234 a

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235a

quadrigemina



236b

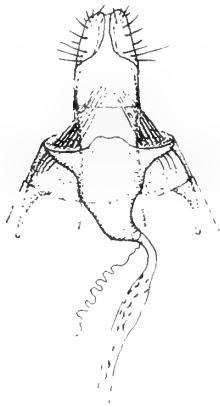


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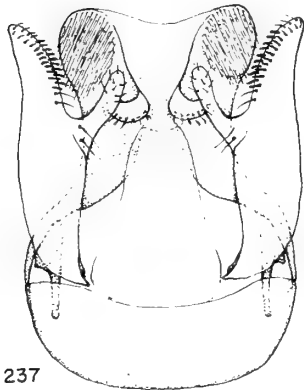
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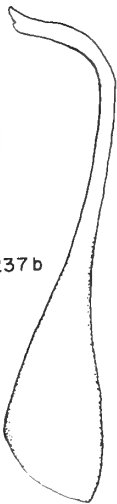
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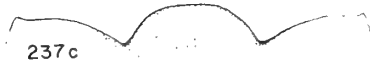
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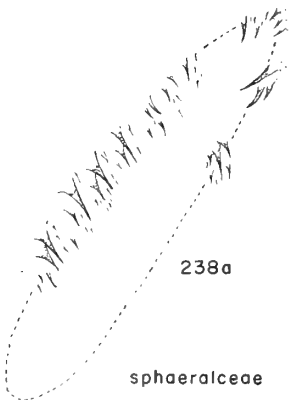


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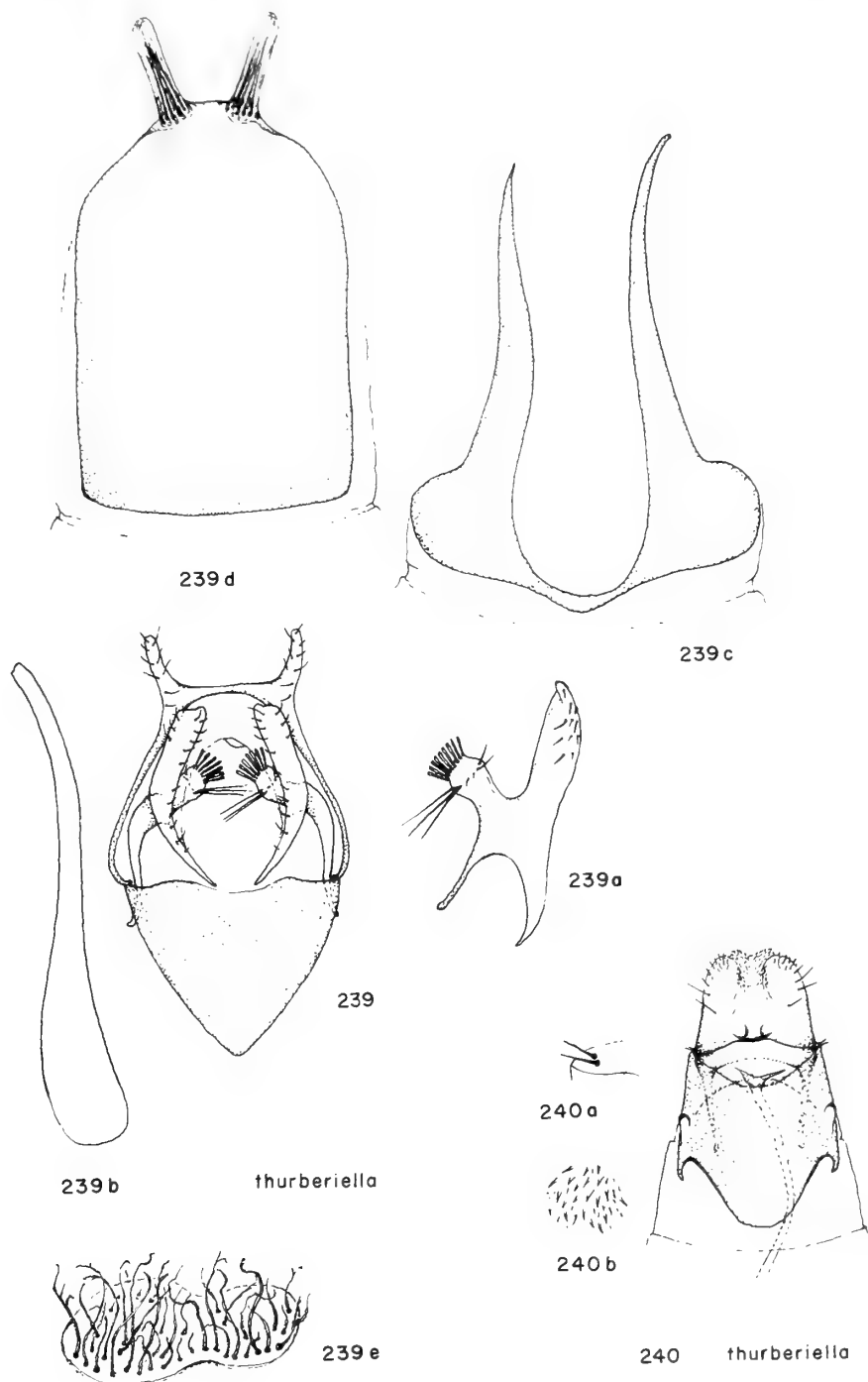
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sphaeralceae



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sphaeralceae



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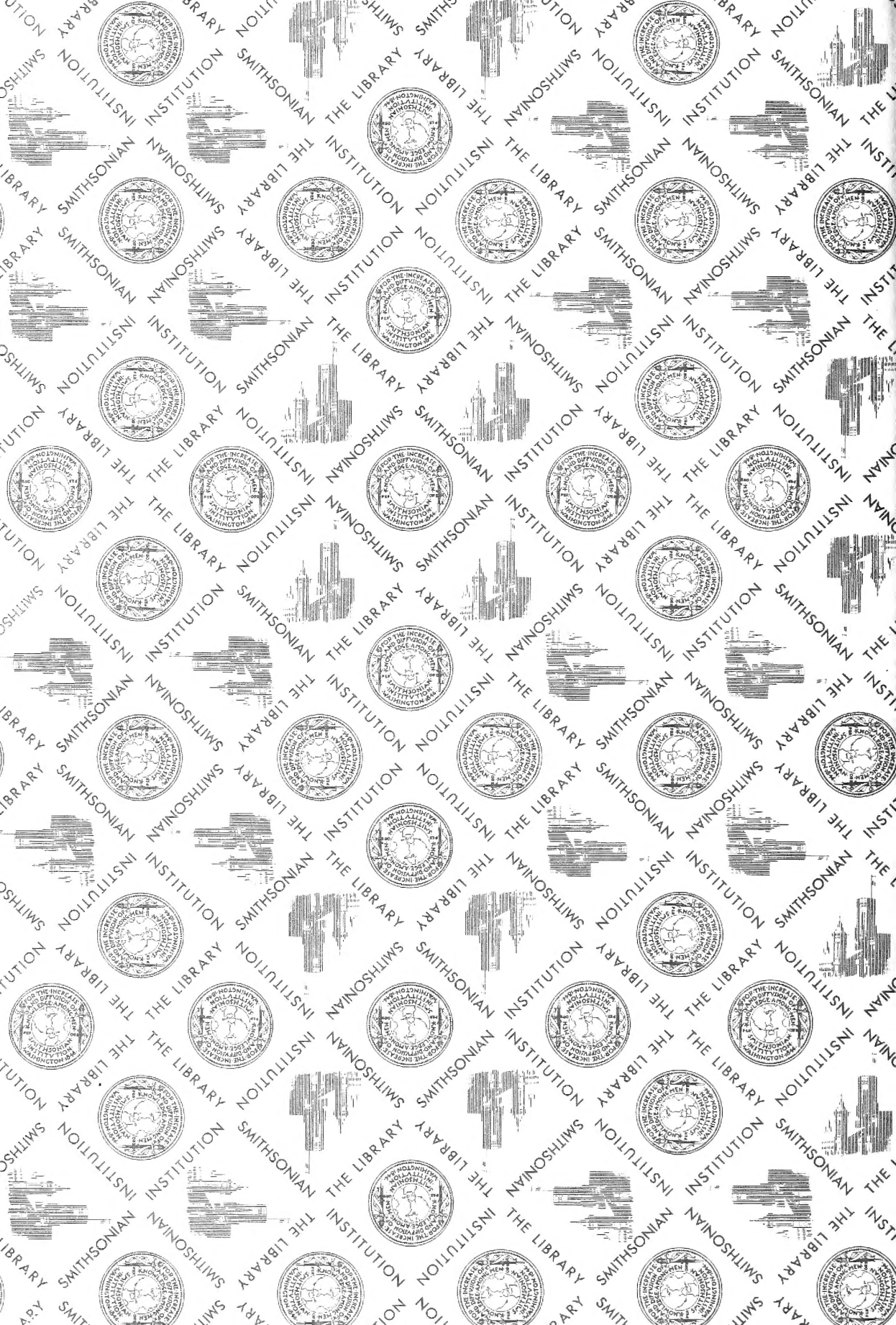
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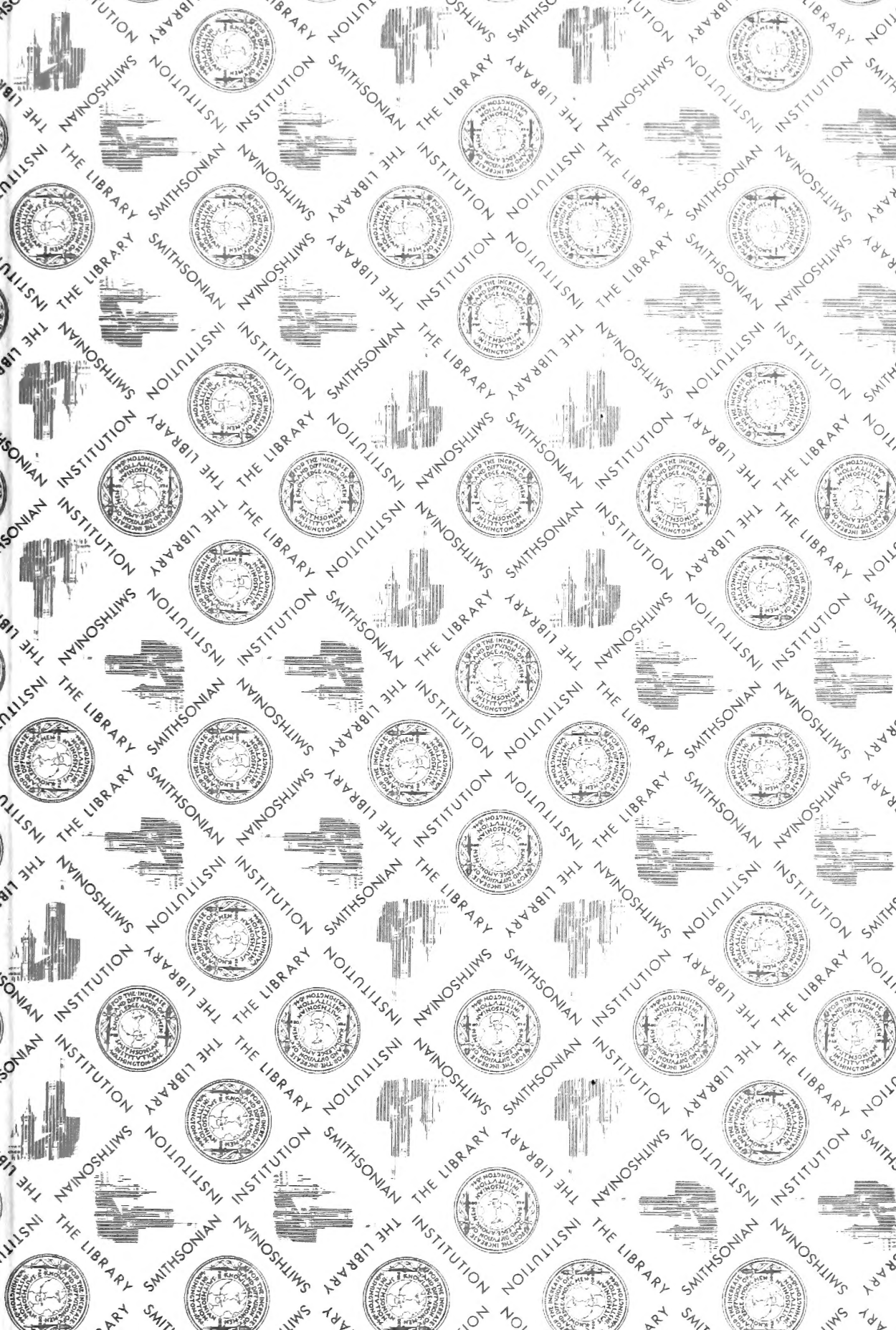
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